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PARAMETIRC SIMLUATION OF TACTICAL SINGLE CHANNEL FREQUENCY MODULATED COMMUNICATIONS

Philip A. Olson Jr.

NAVAL POSTGRADUATE SCHOOL
Monterey, California



THESIS

Parametric Simulation
of
Tactical Single Channel
Frequency Modulated Communications

by

Philip A. Olson Jr.

September 1980

Thesis Advisor: A. L. Schoenstadt

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This thesis presents a stochastic simulation model of single channel FM communications that is designed to be used in conjunction with the Simulation of Tactical Alternative Responses (STAR) Combat Model. The communications modelled, the assumptions made, and the interface requirements necessary for inclusion of the Communications Model in the STAR Combat Model are explained in detail. The computer

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code that is used to execute the Communications Model is included in the appendices. An overview is given of those portions of the basic STAR Model with which the Communications Model interfaces directly to provide the reader with sufficient background for the discussion of the Communications Model. The communications input requirements of the model, a definition of the purpose of each routine and event, and definitions of each global variable, set, and entity are provided so that this thesis can serve as a user's manual for the Communications Model.

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Parametric Simulation of Tactical Single Channel Frequency Modulated Communications

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

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September 1980

ABSTRACT

This thesis presents a stochastic simulation model of single channel FM communications that is designed to be used in conjunction with the Simulation of Tactical Alternative Responses (STAR) Combat Model. The communications modelled, the assumptions made, and the interface requirements necessary for inclusion of the Communications Model in the STAR Combat Model are explained in detail. The computer code that is used to execute the Communications Model is included in the appendices. An overview is given of those portions of the basic STAR Model with which the Communications Model interfaces directly to provide the reader with sufficient background for the discussion of the Communications Model. The communications input requirements of the model, a definition of the purpose of each routine and event, and definitions of each global variable, set, and entity are provided so that this thesis can serve as a user's manual for the Communications Model.

TABLE OF CONTENTS

DOCUMENTATION PAGE ---------- 1
APPROVAL ---------- 3
ABSTRACT ---------- 4
TABLE OF CONTENTS ---------- 5
LIST OF FIGURES ---------- 7
ACKNOWLEDGEMENT ---------- 8
I. INTRODUCTION ---------- 9
II. DESCRIPTION OF THE STAR MODEL ---------- 13
III. COMMUNICATIONS ASSUMPTIONS OF STAR ---------- 18
IV. DESCRIPTION OF THE PROBLEM ---------- 20
V. ASSUMPTIONS OF THE COMMUNICATIONS MODULE ------ 22
VI. DESCRIPTION OF THE COMMUNICATIONS MODULE ------ 25
VII. COMMUNICATIONS MODULE PARAMETERIZATION -------- 53
VIII. COMMUNICATIONS MODULE INPUT REQUIREMENTS ------ 55
IX. FUTURE MODEL ENHANCEMENTS ---------- 59
APPENDIX A STAR ROUTINES, EVENTS, AND ARRAYS -------- 61
APPENDIX B COMMUNICATIONS ROUTINES AND EVENTS ------- 66
APPENDIX C COMMUNICATIONS GLOBAL VARIABLES ---------- 70
APPENDIX D COMMUNICATIONS PERMANENT ENTITIES -------- 73
APPENDIX E COMMUNICATIONS TEMPORARY ENTITIES -------- 77
APPENDIX F COMMUNICATIONS ARRAYS ---------- 80
APPENDIX G COMMUNICATIONS SETS ---------- 86
APPENDIX H ROUTINE DECISION ---------- 87
APPENDIX I ROUTINE DEC.CO ---------- 91
APPENDIX J ROUTINE DEC.BN ---------- 93
APPENDIX K ROUTINE DEC.BDE ---------- 97
APPENDIX L ROUTINE DEC.DIV ---------- 101
APPENDIX M ROUTINE EXIT ---------- 102

APPENDIX N ROUTINE GEN.MOVE.DECISION.MSG ---------- 103
APPENDIX O ROUTINE COM.MAIN ---------- 104
APPENDIX P ROUTINE BUILDNETS ---------- 105
APPENDIX Q ROUTINE CHECKNETS ---------- 107
APPENDIX R ROUTINE BNETTBL ---------- 108
APPENDIX S ROUTINE COMMGEAR ---------- 109
APPENDIX T ROUTINE COMMCHECK ---------- 111
APPENDIX U ROUTINE INITIALIZE ---------- 113
APPENDIX V ROUTINE STAT.DUMP ---------- 114
APPENDIX W ROUTINE SSTAT.DUMP ---------- 115
APPENDIX X EVENT COMMO.ATTEMPT ---------- 117
APPENDIX Y ROUTINE TECH.COMMO ---------- 121
APPENDIX Z EVENT CHANGE.FREQ ---------- 122
APPENDIX AA ROUTINE EW.ROUTINE ---------- 123
APPENDIX BB EVENT NO.CONTACT ---------- 124
APPENDIX CC ROUTINE SIEZE.NET ---------- 125
APPENDIX DD EVENT END.XSMN ---------- 127
APPENDIX EE ROUTINES CO.MSG, BN.MSG, BDE.MSG, and DIV.MSG ---------- 129
APPENDIX FF EVENT DUMP.MAILBAG ---------- 130
APPENDIX GG ROUTINE ABORT.MSG ---------- 131
APPENDIX HH EVENT MSG.GEN ---------- 132
APPENDIX II COMMUNICATIONS OUTPUT EXAMPLE ---------- 134
BIBLIOGRAPHY ---------- 144
DISTRIBUTION LIST ---------- 145

LIST OF FIGURES

FIGURE 1 STAR DECISION LOGIC ---------- 15
FIGURE 2 COMMUNICATIONS ENTITY AND POINTER DIAGRAM -- 26
FIGURE 3 ROUTINE DECISION ---------- 29
FIGURE 4 ROUTINE DEC.CO ---------- 30
FIGURE 5 ROUTINE DEC.BN ---------- 31
FIGURE 6 ROUTINE DEC.BDE ---------- 33
FIGURE 7 ROUTINE DEC.DIV ---------- 35
FIGURE 8 EVENT COMMO.ATTEMPT ---------- 42
FIGURE 9 EVENT END.XSMN ---------- 46
FIGURE 10 ARRAY TABLE DIAGRAM ---------- 63
FIGURE 11 ARRAY BNCORD DIAGRAM ---------- 64
FIGURE 12 ARRAY COCORD DIAGRAM ---------- 65
FIGURE 13 ARRAY BDECORD DIAGRAM ---------- 81
FIGURE 14 ARRAY BNETTBL DIAGRAM ---------- 82
FIGURE 15 ARRAY DIVCORD DIAGRAM ---------- 84
FIGURE 16 ARRAY RRPOINT DIAGRAM ---------- 85

ACKNOWLEDGEMENT

This implementation of communications for the movement decision logic in the STAR Combat Model utilizes a version of the communications model initially developed by Cpt. William Haislip and subsequently modified and revised by Associate Professor Arthur Schoenstadt.

The extensive computer resources required during development and testing of the model were ably provided by the staff of the W. R. Church Computer Center.

I also wish to express my heartfelt thanks to my wife, Linda, without whose dedicated support and nimble fingers this thesis probably would never have gotten through the typing phase.

I. INTRODUCTION

In order to accomplish its mission of winning the land battle, the Army must perform three basic functions: shooting, moving, and communicating. Therefore, it is reasonable to say that any combined arms combat model must portray these three functions with a commensurate degree of accuracy in order to realistically represent the combat process.

The question of precisely how to model communications between the elements, units, and individuals represented in a combined arms combat model is a critical one for the model designer. Communication must be an integral part of virtually every conceptualization of combat more complex than a one-on-one duel. As a result, communication is one of the most significant areas which the combat modeler must consider and with which he must deal effectively.

The assumptions made about the amount of communications allowed between elements, the time required for the communications to be completed, and the effect of communications (or lack thereof) frequently can be so far-reaching that they completely dominate many other effects which the modeler would like to study. They may also cause the model to be rejected as invalid. For this reason, the communications-related assumptions must be carefully thought out and implemented if the combat model is to be realistic and useful.

The original efforts in developing the STAR Combat Model were directed towards producing a high resolution Monte Carlo simulation of modern combined arms warfare. It was decided to base the terrain model on the work done by Needels for his thesis research in March 1976. He

demonstrated that bivariate normal distributions could be used to give a very good functional representation of continuous terrain. The STAR concept was to develop an event step simulation in which the impact point of each direct fire projectile was computed and every firepower activity of the represented elements was simulated insofar as possible. The movement of units, firing of weapons, and all of the related functions such as target acquisition, target selection, attrition, tactics and so on were modeled in considerable detail. Because the model was to focus on the evaluation of weapons and tactics, the original studies set aside the problem of communications for future study in order to get on with the development of the "shooting and movement" portions of the model. A description of the routines, events, and arrays of the STAR model which impact on the development of this thesis is provided in Appendix A.

The original work on the STAR model was done by Hagewood and Wallace in December 1978. At that time and stage of development the model portrayed a blue company under attack by a red battalion. Artillery and close air support/air defense modules were under development but were not included in the model at that time. A dynamic route selection module which considered enemy locations, terrain, and the tactical situation was being considered for inclusion in the model as was an improved module for target selection. In addition, fuel and ammunition resupply modules and a communications module were under development.

In March of 1977, four theses covering those areas mentioned above were written. The first, by Starner , developed a two-sided field artillery stochastic simulation which played both red and blue artillery at the battalion level. Provisions were made for upgrading the model to portray artillery at the brigade level when the brigade level was included in the STAR baseline.

The second, by Kramer, developed a deterministic simulation model for dynamic tactical route selection based upon the route selection technique used in the DYNTACS combat simulation model. Kramer's model was written in FORTRAN, and it was planned for eventual incorporation into the STAR model.

The third, by Broussard, developed a dynamic model for the tank commanders' target selection process based on eleven parameters fit by a regression model using responses from 128 tank gunners.

Finally, the fourth, by Haislip, developed a stand-alone communications model which will be discussed in a later paragraph.

In September of 1979, Caldwell and Meiers developed an air-to-ground and ground-to-air combined arms simulation designed for inclusion in the STAR model. At this time, STAR had been upgraded to include representation of a blue battalion under attack by a red regimental force; however, the production version which was used for several studies for TRADOC still did not include any of the modules such as the field artillery, dynamic route selection, dynamic target selection, or communications.

In his thesis work in March 1979, Haislip developed a model for single channel FM communications at the company and battalion level. Despite the fact that this code was written with the idea of incorporating it into STAR, there were several shortcomings which precluded its inclusion. First and most significant, the code was task specific so that in order to use it for the wide range of applications represented in the STAR model much of the logic and many of the variable and attribute names would have had to be altered. Second, the communications model only portrayed the communications for internal platoon fire coordination and field artillery fire direction. It was subsequently decided

that, for the near term, STAR would not explicitly model the communications below the company level for reasons which will be outlined in Chapter V. In spite of these shortcomings, the model written by Haislip did provide valuable insights into how to approach the problem of user-transparent communications modules for the higher echelons.

Since the purpose of this thesis was to design and implement a communications model for the movement decision logic within the framework of the existing STAR Combat Model, Haislip's work was used as the basis for the communications implementation with modifications and extensions in order to make the communications interface as robust as possible within the constraints imposed by the existing STAR organization. A description of the routines and events of the communications model is provided in Appendix B.

Because of the evolutionary nature of the STAR model there are always several "current" versions of the model in some stage of work. For the remainder of this thesis, any reference to STAR is a reference to the current production version of the model which does not include those modules under development. Also, references to the communications model refer to that module which was developed as a stand-alone model of the communications process using the decision logic flow from the production version of STAR. Hopefully, this communications module will be enhanced and included in one of the STAR baseline production models scheduled for completion later this year.

II. DESCRIPTION OF THE STAR MODEL

The STAR combined arms model is being developed at the Naval Postgraduate School to investigate the effectiveness of both tactical doctrine and materiel in a mid-intensity combined arms conflict. As previously noted, the model uses functionally generated continuous terrain and currently simulates a blue battalion under attack by an armor heavy red regimental force. The terrain currently in use simulates a 10 kilometer by 10 kilometer area near Fulda, Federal Republic of Germany; however, other terrain boxes have been developed including one 40 kilometers by 80 kilometers which is planned to be used with simulation of a blue brigade-level force under attack by a red division-level force.

The current version of STAR simulates individual weapons systems such as XM1 tanks, TOW's, BMP's, T72 tanks, and dragons. These entities detect enemy systems, select and acquire targets, load and fire their weapons, and move about the simulated battlefield based upon input parameters supplied by the model user. The user defines the types of weapon systems, the ammunition available, the tactics to be used for selecting and engaging targets, and the force ratio and range breakpoints used to determine if a unit wants to withdraw from its current position. A line-of-sight module is used to determine whether or not one system can see and, therefore, engage an enemy system based upon their respective locations on the continuous terrain.

Air defense, dismounted infantry, and artillery modules are under development for inclusion in the model. Also, preliminary work has been done on a vehicle evacuation and repair module to simulate one of the major logistics

functions.

During the initialization process for the STAR model, each company is assigned a weight based upon the users' view of the importance of the particular company in the overall defensive posture of the battalion. This value, COWT, is an attribute of the company for a particular phase line and is used by the movement decision logic. A company can and frequently does have different values of COWT for different phase lines. Also during the initialization, the user assigns a value to column 4 of the array TABLE for each company and weapon system on every phase line. This value represents the restriction status of the unit and must be a one or a zero. If the value is a one, the company or weapon system is restricted from moving from that phase line position unless given permission by its superior commander. If the value is zero, the company or weapon system can move at will. TABLE also stores codes for all of the tactical actions allowed for each company and weapon system on each phase line. Associated with each of these action codes, the TABLE array contains a force ratio and an attrition level which trigger the action to be taken. (Technical Report NPS55-79-023 by Parry and Kelleher contains a complete description of the parameters stored in array TABLE.)

The movement logic in STAR is handled by Routine DECISION which uses the unit number of the unit requesting or being ordered to move, the row number in the TABLE array of the weapon system to be moved by the unit, and the appropriate column number in the TABLE array. This information is combined with whether or not the weapon system is restricted from moving from its present phase line position, which is in column 4 of the TABLE array. A flow diagram of the logic in Routine DECISION is given in Figure 1. The arrays used by the movement decision logic are described in Appendix A.

STAR DECISION LOGIC

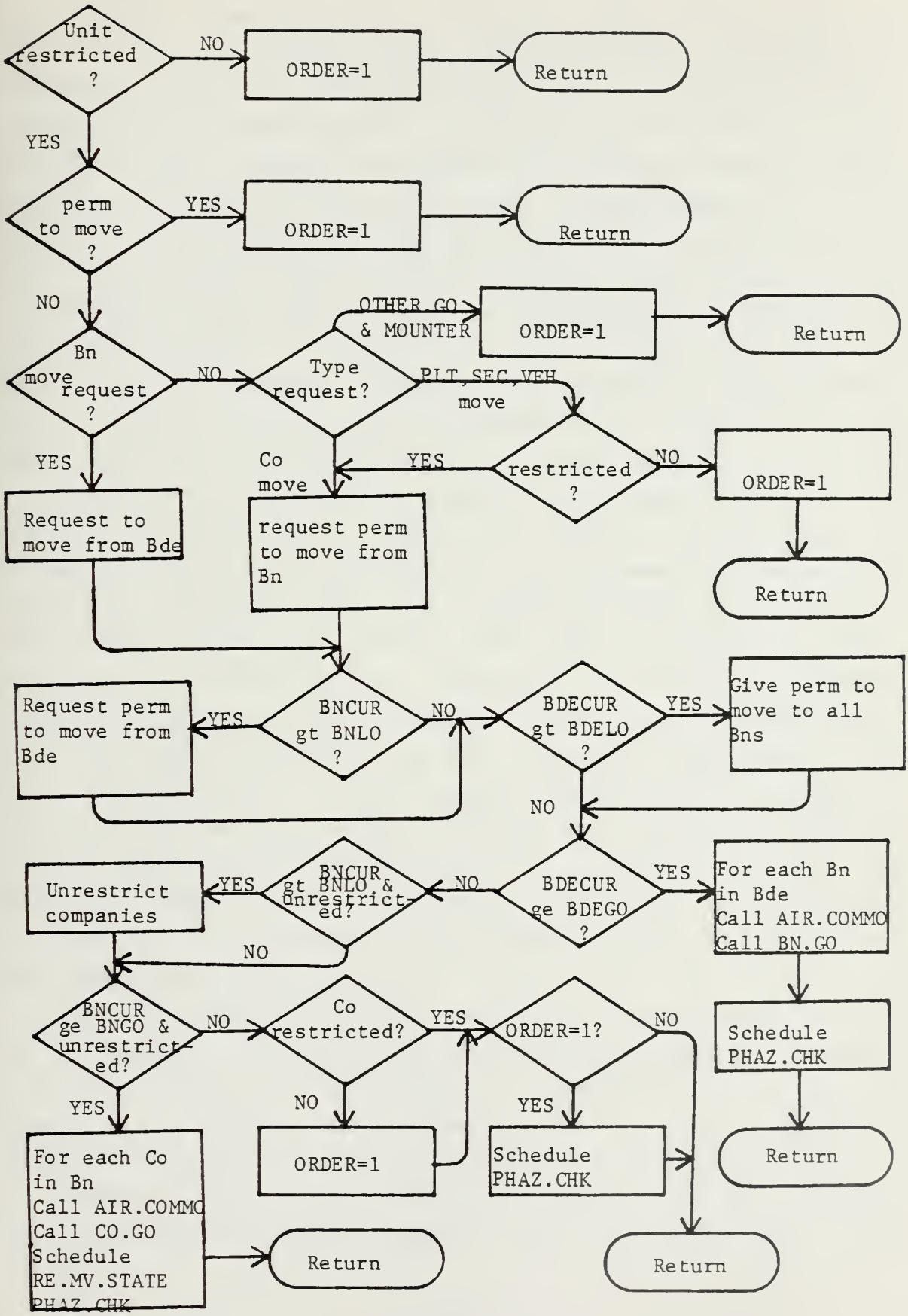


FIGURE 1

During simulation of a battle, blue forces may be allowed by the model users' choice of input parameters to move out of their current position as a result of heavy attrition by enemy forces or because of the range to the nearest enemy element. Each shot at a blue element causes routine BUG.CHK to check the range to the enemy. If it is less than the value supplied by the user in column three of the array TABLE for that phase line and that weapon system or company, then routine DECISION is called to determine if the weapon system or company is restricted or is allowed to move from its current position. Similarly, routine ACTION calls routine DECISION as blue systems are killed by enemy fire and force ratio decision points are reached.

In order to determine when a battalion will give its companies permission to move and when it will order its companies to move, each battalion has three attributes. Two of these, BNLO and BNGO, are assigned values by the user. The third, BNCUR, is set to zero when a battalion first occupies a phase line. Whenever a company requests permission to move, its weight is added to the BNCUR value. If this value exceeds the user defined BNLO value, the battalion gives all of its companies permission to move at will. If the value of BNCUR exceeds the user input value of BNGO, the battalion orders all of its companies to move. As long as BNCUR is less than BNLO, restricted companies and systems of that battalion stay restricted and are not given permission to move.

When routine DECISION is called, the restriction status of the company or weapon system in array TABLE is checked, and the BNCUR value is updated if required. Then, if the company or system is allowed to move, the appropriate movement routine is called to handle the movement process.

Since in the current version of STAR all of the checking of the company status, updating of the BNCUR value, and

calling of the movement routines is done in the same routine, an assumption is made of perfect and instantaneous communications from the company to the battalion and back to the company. This and the other assumptions of STAR dealing with the communications and decision processes are discussed in the next chapter.

III. COMMUNICATIONS ASSUMPTIONS OF STAR

The current STAR Combat Model makes several far-reaching assumptions concerning communications during simulated battles. These assumptions are driven by the fact that neither communications nor electronic warfare is modeled explicitly in the current production version of STAR. As noted in Chapter I, the modeling of these phenomena were left for later work by the original studies done on STAR. In order of decreasing importance the implicit assumptions made in the STAR model concerning communications and electronic warfare are listed and explained below.

1) Communications of information from one element to another takes no time. This assumption means that a primary effect of communications on the battle process, the time it takes to reach decisions and affect the actions or posture of remote units, has been ignored.
2) Communication between units is independent of the locations of the units and of the intervening terrain. In practice, the intervening terrain often precludes any communication between units.
3) All designated recipients of a communication receive exactly the same information at exactly the same time. This means that messages are never lost and all are handled with perfect efficiency.
4) The probability of successful communications between two elements is not affected by the combat situation nor by the kill condition of either element. This means that communications gear is never damaged during the battle to such an extent that it cannot be repaired by the operator, or replaced.

5) All methods of communications are equivalent since they all take no time and they all have the same probability of success.

6) All commanders are always instantaneously aware of a change in the status of any of their units.

Of these six assumptions, the one of paramount importance is the first because of its great effect on the outcome of the battle. This thesis focuses on implementing a communications model for the movement decision logic of the STAR model and on providing a method of modeling messages so that this first assumption can be eliminated in favor of one which deals only with the distribution of the time delays caused by transmission of messages from one entity to another.

A description of the problems caused by these assumptions is presented in the next chapter.

IV. DESCRIPTION OF THE PROBLEM

Because of the intense effort to implement a production version of STAR as an effective combined arms combat model, the development of the communications aspects of the model has not been the primary concern of the model developers. The predominant view concerning communications between units has been that the oversimplified portrayal would be adequate until such time as the model was sufficiently sophisticated to allow the communications to play a significant role in the exercise of the model.

The lack of an adequate communications model as outlined above together with the assumptions of the STAR model regarding communications which are stated in Chapter III have a great effect on the results of the model in certain critical situations. For example, since the loss of time in transmitting information is ignored, the battalion commander is instantly aware when one of his companies is being heavily attrited by the enemy and wants to withdraw from a particular position, and no time is taken up by the decision process which generates the order or the communication process which transmits the movement authorization to the company. This, in turn, means that this particular blue company is, on the average, attrited less than it would be if the company had to wait some length of time to get permission to move from its current position. Thus blue casualties are lower than they would be for a more realistic simulation of the decision and communications process.

This thesis work was begun at a time when it was decided that a more detailed treatment of communications was necessary. It was determined that this was an area of the

model where significant improvements in model realism could be made. At the same time, it was apparent early in the development of the communications model that major portions of the STAR code would have to be completely rewritten to implement a realistic communications simulation model. Many of the decisions which are based upon communicated information are "hard-wired" into the STAR code which means that in order to change these decisions, the code itself had to be radically altered to provide for more flexibility. As noted previously, this thesis work was begun with the goal of implementing a communications model within the STAR model which would handle the message flow for the movement decision logic. This model was to be sufficiently flexible and expandable to handle the communications requirements for other functions as they are converted to the explicit communications representation. A description of the assumptions of the communications model is provided in the next chapter.

V. ASSUMPTIONS OF THE COMMUNICATIONS MODULE

The communications model developed in this thesis makes the following assumptions.

1) A message on the communications net will not be interrupted by another message trying to get on the net. This means that there is no scheme for handling different message precedence levels.
2) Human error in interpretation of the messages is negligible.
3) Signal strength during transmission of a specific message does not vary significantly.
4) The probability of jamming a given message is independent of whether or not a previous message on the same net was jammed.
5) None of the unit commanders are killed during the course of the battle. This is accomplished by setting all the commanders ammo counts to zero and by setting each commander's ACVT.TYPE attribute equal to one.
6) Below the company level, communications by messenger takes approximately the same time as electrical communications and therefore communications at this level is assumed and is not modeled.

Some brief comments on these assumptions are in order and they are provided below.

Until such time as the communications model is sufficiently sophisticated to allow for modeling of traffic priority, the first assumption provides an adequate model for a process where all traffic is of the same relative importance.

The second assumption covers a multitude of faults which

exist in the real world communication process. However, just as it is not feasible to try to model the differences in viewpoint between the red and blue commanders except in terms of doctrine, it is not feasible to try to model the possible ways a message can be misinterpreted since this is a function of so many disparate factors.

The third assumption provides a good approximation to reality except during bad weather when atmospheric conditions change with great rapidity, and when jamming is encountered. This assumption has an explicit proviso, that is that the message lengths must be short relative to the time scale for atmospheric or equipment changes.

The fourth assumption is applicable to this version of the communications model but will undoubtedly be superceeded by later revisions which are anticipated to model the phenominon of jamming in great detail. In the current version the probability of jamming is set by the user by his choice of the values for the global variables which are used by the SIMSCRIPT random number generator. A description of the global variables used in the communications model is provided in Appendix C.

The fifth assumption is made because this entire area of battlefield synergism is not being played in the model. In real combat, commanders are killed and units lose or gain effectiveness based upon the capabilities of the subordinates who assume command. There is no data to support any sort of model of this gain/loss of effectiveness, and it is not anticipated that any attempt will be made to incorporate this sort of detail in the model since it turns primarily on capabilities of individuals such as leadership, judgment, and decisiveness which are essentially not quantifiable.

The rationale for the sixth assumption and for not modeling the communications below the company level is that

these emitters are generally so close together that it is almost always possible to pass traffic between them, and jamming them becomes prohibitively expensive in terms of level of effort and expenditure of resources. Also, because they are relatively close together, critical information can be passed by messenger in a time that is roughly equivalent to the time required to pass the information by electronic methods. This is not true for messages between the higher level commanders where the time for a messanger to deliver the information would be orders of magnitude larger than the time to deliver the information by electronic means. In addition, modeling all these details would consume valuable computer resources which can be more profitably used to represent other aspects of the combined arms battle.

Unlike the communications model currently employed by the STAR model which assumes no loss of time in transmitting information from one unit to another during the course of the battle, the one developed in this thesis provides the user of the model with almost complete freedom in his choice of how to model the distributions of the time delays involved in the communications and decision processes. The guidelines for model parameterization are covered in detail in Chapter VII. A complete description of the communications model is provided in the next chapter.

VI. DESCRIPTION OF THE COMMUNICATIONS MODULE

The communications model developed in this thesis is an amalgum of ideas and concepts from many sources. The logic of the STAR model necessarily makes many decisions which in real life are based upon information communicated to the commanders by sources outside their immediate area. Most of this information is provided to the commander in the form of a written or verbal message. While these messages do not conform to any set format, there are certain minimum essential elements of information contained in them which are determined by the type or intent of the message. For example, as a minimum, a request by a company for permission to move from a specified position must include a unit designator and some type of code to identify this message as a request to move. Since different types of messages will necessarily have different minimum information contents, it was decided that the messages and their text portions should be modeled separately. In order to help the reader with understanding the logic flow which will be discussed in this chapter, the entities and their pointers which are used by the communications logic are diagrammed in Figure 2. Also, the arrays and sets used by the communications logic are described in Appendices F and G respectively.

To represent the flow of information within the model, messages are generated as temporary entities whenever a decision point is reached where information must be passed between two subscribers which are spatially separated or are not from the same command level. There is one exception to this policy: the internal company communications. Communications from individuals to their platoon leaders and from the platoon leaders to the company commanders are

COMMUNICATIONS ENTITY AND POINTER DIAGRAM

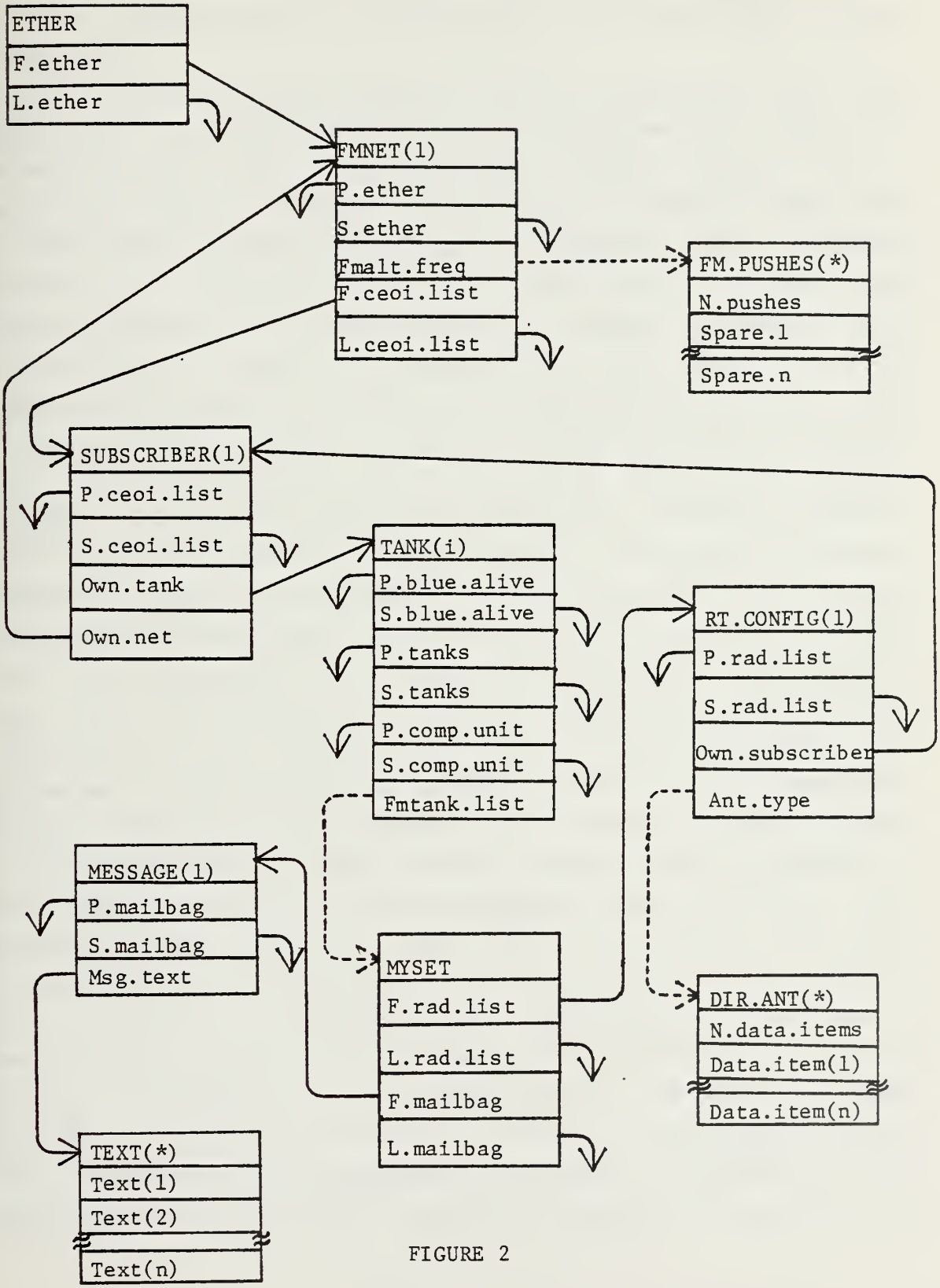


FIGURE 2

assumed to be 100% reliable and take no time. This is not the case for communications between the company commanders or for communications between any of the higher level commanders.

The communications module being implemented uses the same basic decision logic as that diagrammed in Figure 1. However, since the primary emphasis of this thesis was to model the communnications delays and the effects they have on the eventual outcome of the simulation, the DECISION routine had to be completely rewritten to allow the representation of these delays. Routine DECISION was actually taken apart and broken down into seven mutually disjoint new routines. These seven routines utilize the same arrays and sets as the original DECISION routine to model the decision process. Four of these routines, DEC.CO, DEC.BN, DEC.BDE, and DEC.DIV, handle the movement decision logic at the various command levels. The fifth routine, DECISION, acts as the driver which initiates the movement decision process when called by either BUG.CHK or ACTION from the STAR logic. The sixth routine, EXIT, provides an exit from the movement decision logic under specified conditions. The seventh routine, GEN.MOVE.DECISION.MSG, produces the appropriate message which is transferred between these routines carrying the information required for the decision to be made. These routines are discussed in more detail later in this chapter along with all the communications routines and events necessary for the transfer of messages between them. The SIMSCRIPT code for these modules is provided in Appendices H through O respectively. Instead of changing the information known by all the commanders at all levels when a company commander decides to request permission to move, the communications model stochastically generates and sends a MESSAGE from the company commander to the battalion commander containing the

request. When this MESSAGE transmission ends, the model provides the STAR decision logic with the information necessary for a decision by the battalion commander and then stochastically models the transmission of the decision by generating and sending a MESSAGE from the battalion commander to the company commander. If the users choice of inputs does not allow the battalion commander to give permission to move to the company commander, another MESSAGE is generated and sent. This new MESSAGE goes to the brigade level and when the transmission ends, the decision logic at the brigade level either generates the decision and sends a MESSAGE back to the battalion or passes a further request for permission to move on to the division level. As the model stands, the division level cannot send a message higher and thus is the ultimate decision authority. The user should be aware that his choices of break point bounds and restriction status for the simulated units are critical for a realistic simulation. Flow diagrams of the modified decision logic used in the communications model are given in Figures 3, 4, 5, 6, and 7. In addition, a partial listing of the output of the model is provided as Appendix II. This listing has been greatly shortened, but serves to illustrate the type of output which can be expected from the model during execution. A description of the flow of the communications model routines and events will be given next to familiarize the reader with the details of the model.

A. COM.MAIN

The SIMSCRIPT code for routine COM.MAIN is provided in Appendix C. It is the first of the communications model routines to be executed. It is called from BL.CREATE and it in turn calls all the initialization routines for the

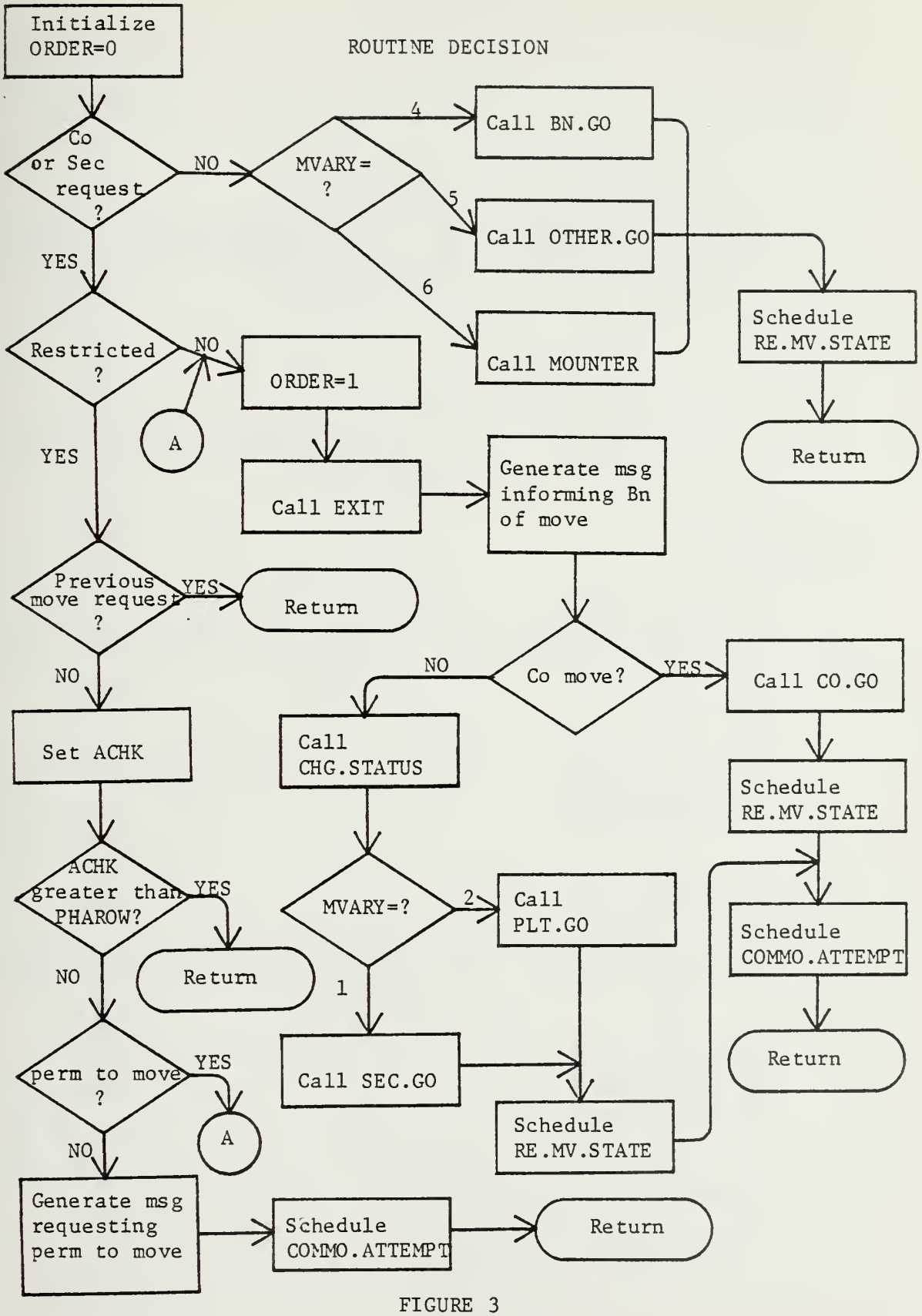

ROUTINE DECISION
Initialize ORDER=0
Co or Sec request ?
NO
MVARY= ?
4
Call BN.GO
5
Call OTHER.GO
6
Call MOUNTER
Schedule RE.MV.STATE
Return
YES
Restricted ?
NO
ORDER=1
A
YES
Call EXIT
Generate msg informing Bn of move
Previous move request ?
YES
Return
NO
Co move?
NO
YES
Call CO.GO
Set ACHK
Call CHG.STATUS
Schedule RE.MV.STATE
ACHK greater than PHAROW?
YES
Return
MVARY=?
2
Call PLT.GO
Schedule COMMO.ATTEMPT
NO
1
Return
perm to move ?
YES
A
Call SEC.GO
Schedule RE.MV.STATE
NO
Generate msg requesting perm to move
Schedule COMMO.ATTEMPT
Return

FIGURE 3

ROUTINE DEC.CO

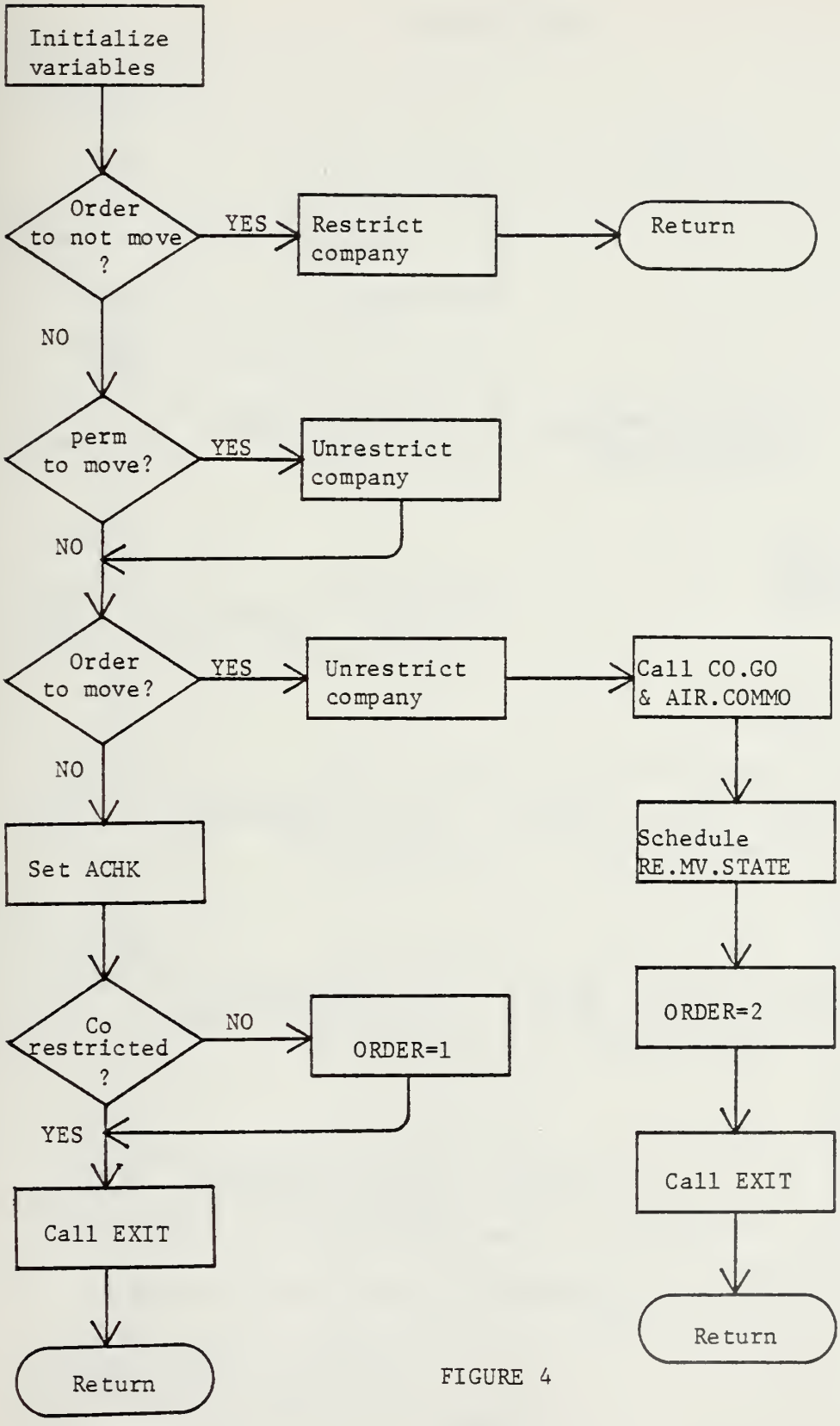


FIGURE 4

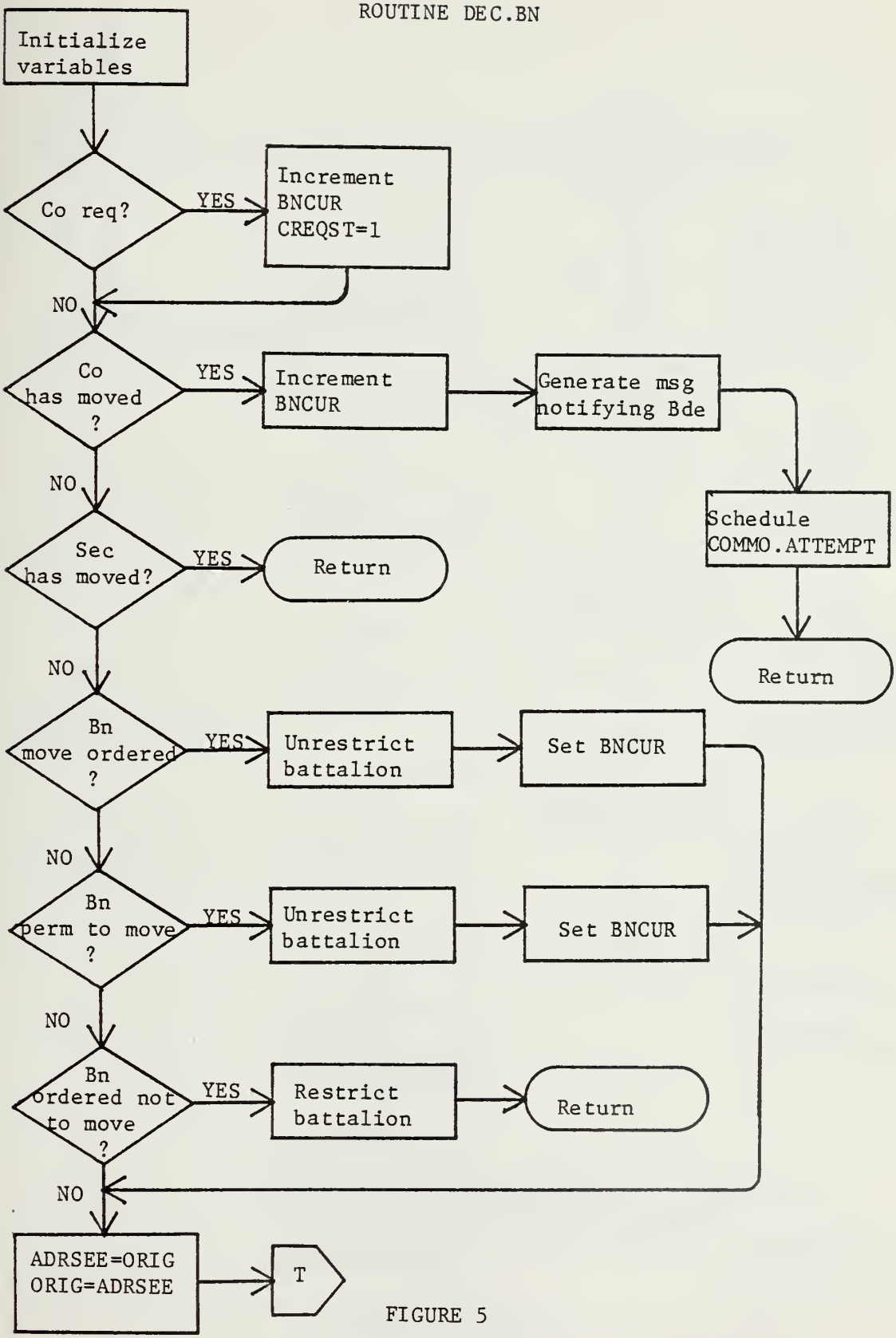

ROUTINE DEC.BN
Initialize variables
Co req?
YES
Increment BNCUR CREQST=1
NO
Co has moved ?
YES
Increment BNCUR
Generate msg notifying Bde
Schedule COMMO.ATTEMPT
Return
NO
Sec has moved?
YES
Return
NO
Bn move ordered ?
YES
Unrestrict battalion
Set BNCUR
NO
Bn perm to move ?
YES
Unrestrict battalion
Set BNCUR
NO
Bn ordered not to move ?
YES
Restrict battalion
Return
NO
ADRSEE=ORIG ORIG=ADRSEE
T

FIGURE 5

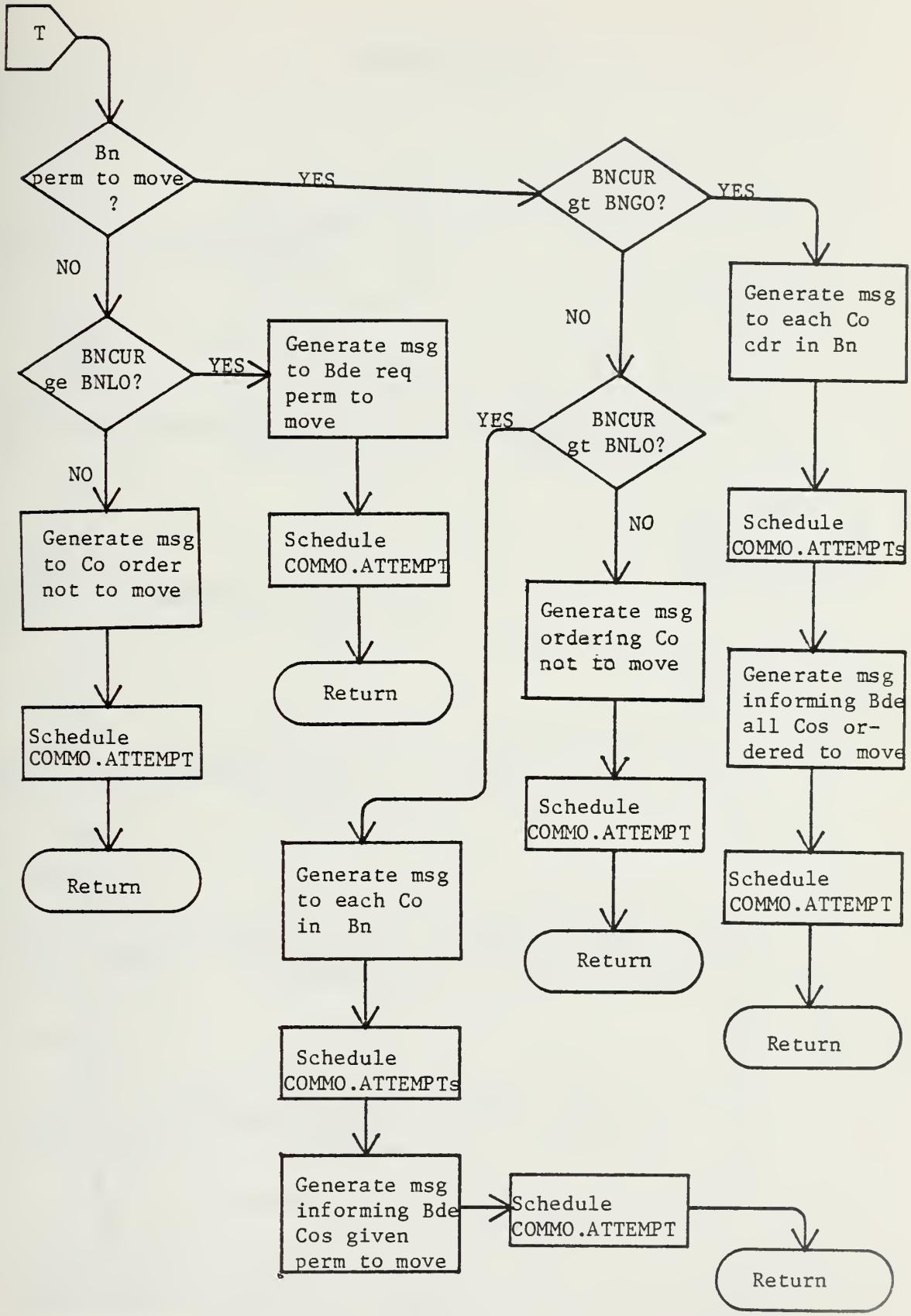


FIGURE 5 (cont.)

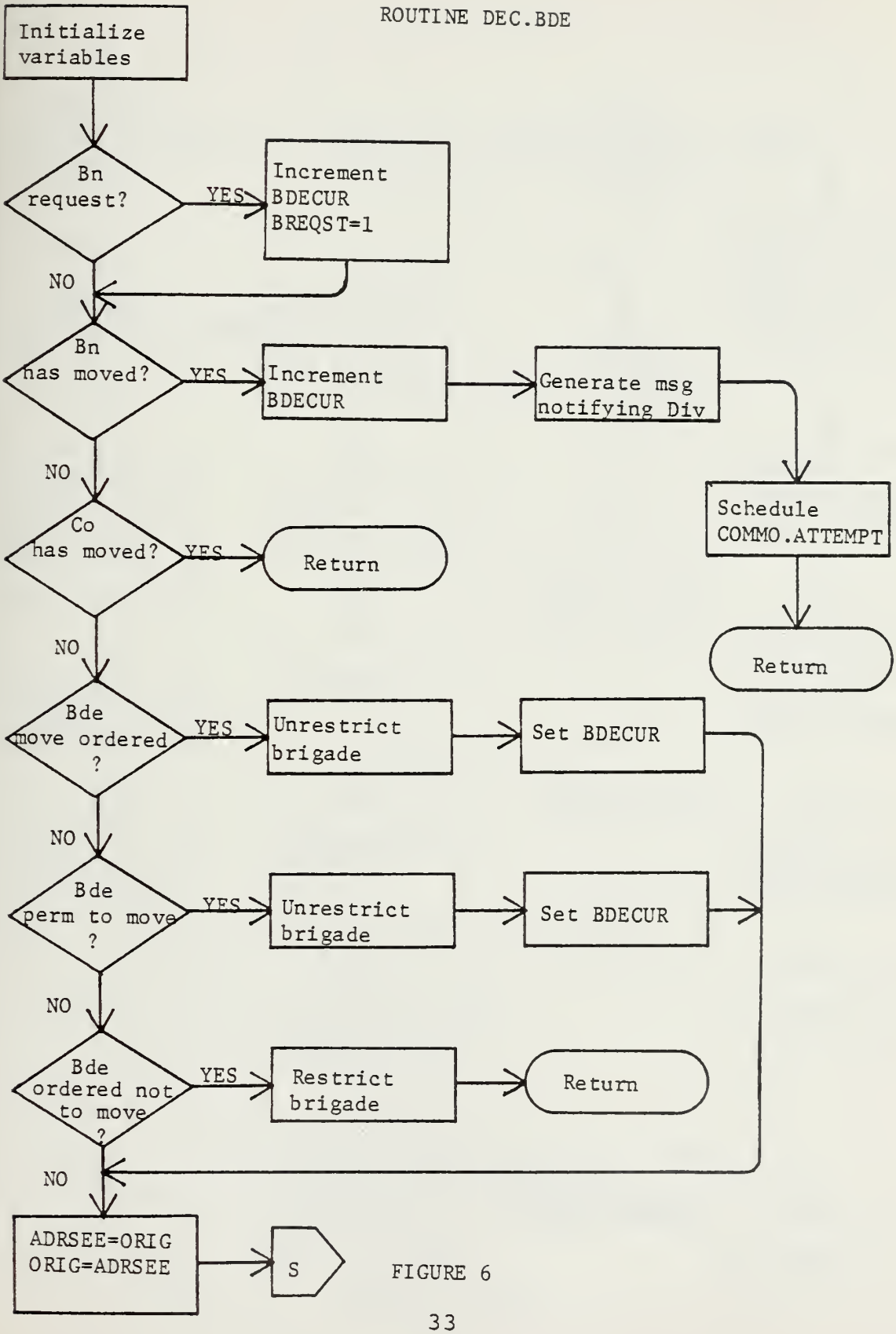

ROUTINE DEC.BDE
Initialize variables
Bn request?
YES
Increment BDECUR BREQST=1
NO
Bn has moved?
YES
Increment BDECUR
Generate msg notifying Div
Schedule COMMO.ATTEMPT
Return
NO
Co has moved?
YES
Return
NO
Bde move ordered ?
YES
Unrestrict brigade
Set BDECUR
NO
Bde perm to move ?
YES
Unrestrict brigade
Set BDECUR
NO
Bde ordered not to move ?
YES
Restrict brigade
Return
NO
ADRSEE=ORIG ORIG=ADRSEE
S

FIGURE 6

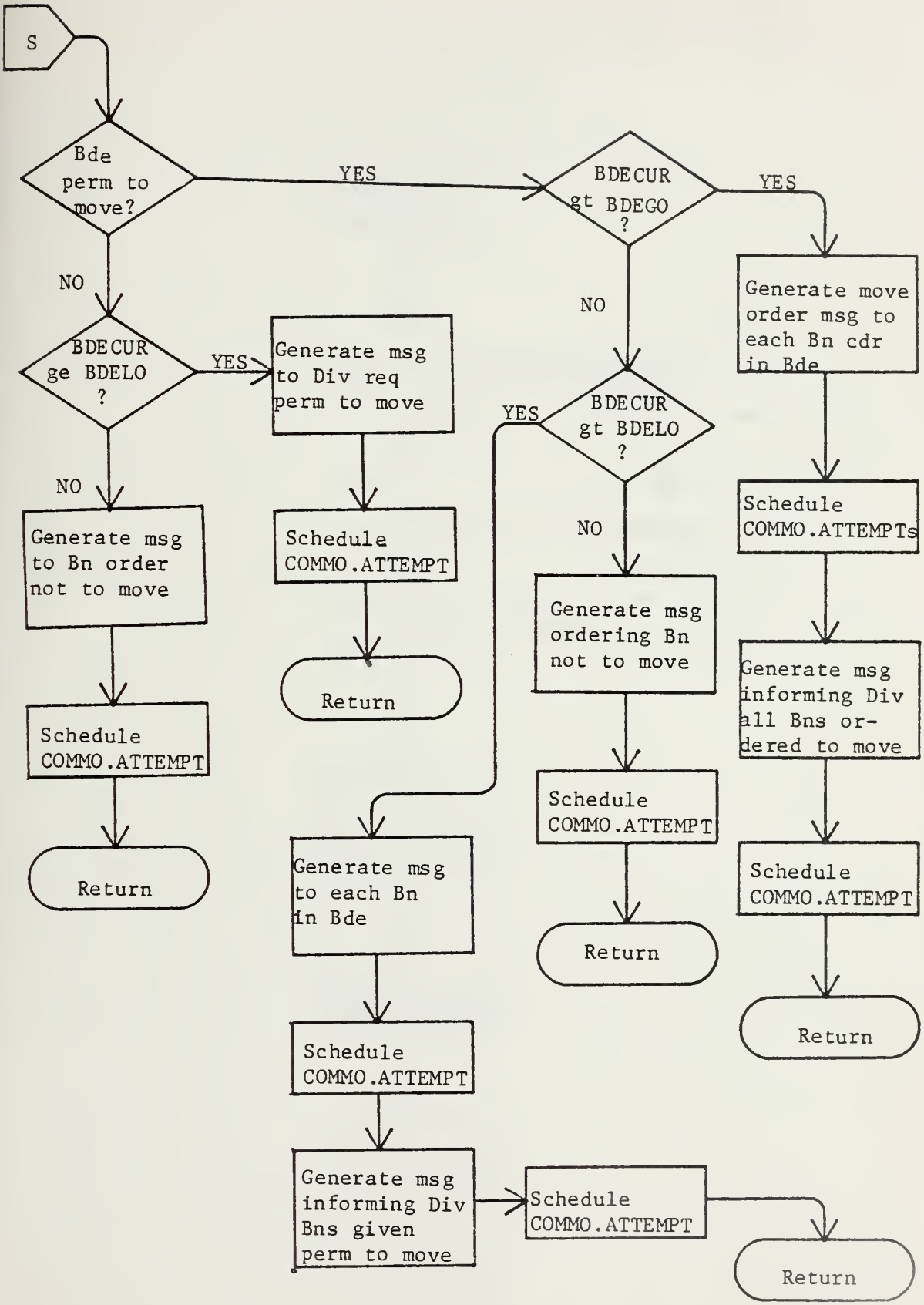


FIGURE 6 (cont.)

ROUTINE DEC.DIV

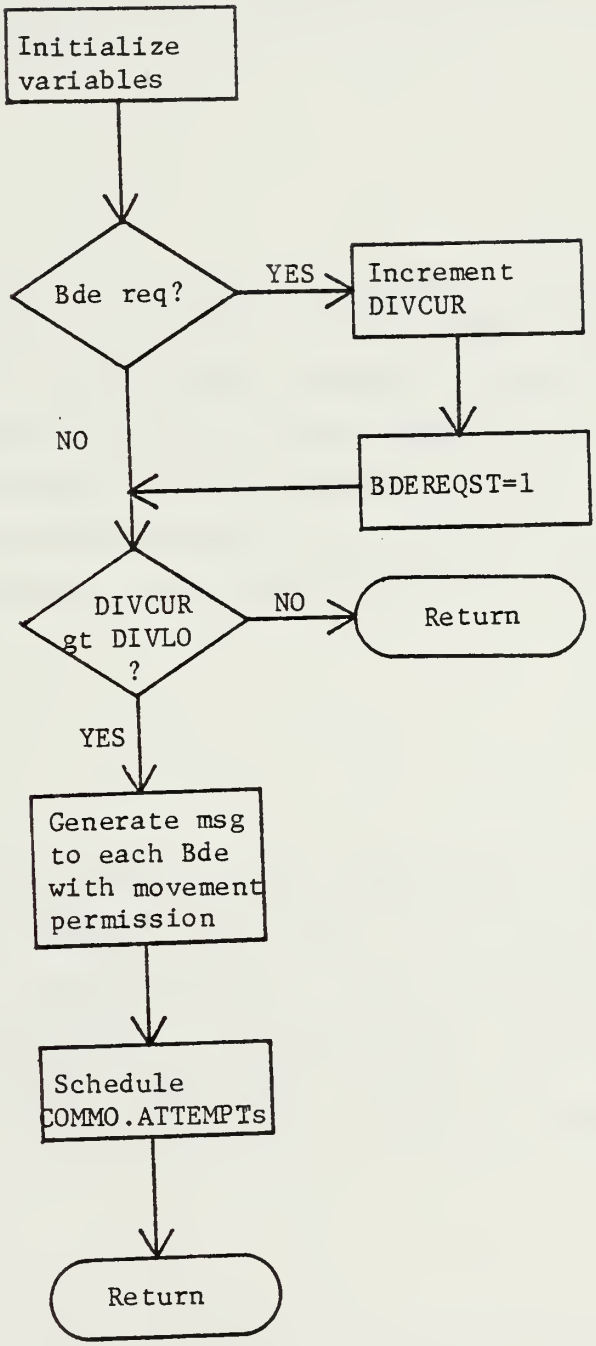


FIGURE 7

communications module before listing the attributes of each B.MVR.CDR, COMPANY.COMMANDER, BN.COMMANDER, BDE.COMMANDER, DIV.COMMANDER, and UNIT. COM.MAIN is the last executable routine called by BL.CREATE, and when it terminates, the SIMSCRIPT timing routine takes control since the simulation has already been started.

B. BUILDNETS

The SIMSCRIPT code for routine BUILDNETS is provided in Appendix P. It reads in the data on the FMNETs which are to be simulated and on which UNITs belong to each FMNET. It then creates the nets and the SUBSCRIBERs and places the SUBSCRIBERs in the CEOI.LIST for their net. It also reads any alternate frequencies which are assigned to the FMNET and stores them in the array FM.PUSHES. It then returns control to COM.MAIN.

C. CHECKNETS

The SIMSCRIPT code for routine CHECKNETS is provided in Appendix Q. It goes through each FMNET that has been created and prints out the information on them. It prints the net number, the net frequency, the number and frequency of any alternate frequencies, and the number of SUBSCRIBERs assigned to the net before returning control to COM.MAIN.

D. BNETTBL

The SIMSCRIPT code for routine BNETTBL is provided in Appendix R. It cycles through all the FMNETs and creates and

prints out two tables. The first, NETTBL, is used during execution of the communications routine. It contains the identity numbers of the SUBSCRIBERs belonging to the ith FMNET in the ith row. The second table has the address pointers to the SUBSCRIBERs in the ith FMNET in its ith row. After printing both tables, BNETTBL returns control to COM.MAIN.

E. ROUTINE COMMGEAR

The SIMSCRIPT code for routine COMMGEAR is provided in Appendix S. It reads in the data on how many UNITS/TANKS have communications equipment and creates a MYSET for each of them. It then creates the RT.CONFIGs for each TANK and reads in the characteristic data for each RT.CONFIG assigned to each TANK and files the information as attributes of the RT.CONFIG. If the data indicates that the antenna is directional or remoted, a message is printed and the job terminates since there are no provisions in the current model for handling directional or remoted antennas. Eventually, these are planned for inclusion, however. The routine then cycles through the FMNETs and sets the first message number for each SUBSCRIBER in each net equal to n001, where n is the identity number of the SUBSCRIBER. Finally, this routine places the SUBSCRIBERs in the nets and returns control to COM.MAIN.

F. ROUTINE COMMCHECK

The SIMSCRIPT code for routine COMMCHECK is provided in Appendix T. It cycles through each TANK in BLUE.ALIVE and prints out the communications gear assigned to each TANK.

For each RT.CONFIG it prints out the x,y, and z coordinates, the type of radio, the radio mode of operation, the antenna type, and the location of the antenna which currently must be the same as the location of the TANK. If either a directional or remoted antenna is detected, a message is printed and the program halts. This is done because the routines which are planned to handle this have not yet been included in the model. Finally, it prints the number of the net to which each RT.CONFIG is tuned before returning control to COM.MAIN.

G. ROUTINE INITIALIZE

The SIMSCRIPT code for routine INITIALIZE is provided in Appendix U. It reads in the values for the parameters used by the communications routines for generating random numbers and for controling the print out of data. It also reads in the lower and upper bounds for the destination codes of messages being sent to the company, battalion, brigade, and division levels. It also calls routines STAT.DUMP and SSTAT.DUMP before it returns control to COM.MAIN.

H. ROUTINE STAT.DUMP

The SIMSCRIPT code for routine STAT.DUMP is provided in Appendix V. It lists the attributes of each COMPANY.COMMANDER, BN.COMMANDER, BDE.COMMANDER, and DIV.COMMANDER and is used primarily as an aid to debugging. In addition to the initial call from routine INITIALIZE, it is called from routine END.XSMN periodically based upon the value supplied by the user for global variable COM.DATA.DUMP. Complete descriptions of the global variables

used in the communications model are provided in Appendix C while the attributes of the permanent and temporary entities are described in Appendices D and E respectively.

I. ROUTINE SSTAT.DUMP

The SIMSCRIPT code for routine SSTAT.DUMP is provided in Appendix W. It prints out the contents of the BDECORD, BNCORD, and COCORD arrays. This is another of the print routines designed to aid in debugging the code if it should fail. The arrays used in the communications model are listed and explained in Appendix F.

Once initialization of the modules has been accomplished and the SIMSCRIPT II.5 timing routine has taken control of the system, the event step sequence determines the order in which the routines and events will take place. The following description of the routines and events is done as if tracing the flow of a specific decision through the system. Whenever in the following narrative the phrase "a message is sent" is encountered, it should be taken to mean "a COMMO.ATTEMPT is scheduled."

J. ROUTINE DECISION

The SIMSCRIPT code for routine DECISION is provided in Appendix H. The flow diagram for the logic of routine DECISION is given in Figure 3. DECISION is called by either BUG.CHK or ACTION from the STAR logic. Both of these routines were significantly altered to allow them to interface with the new decision logic routines. Routine DECISION checks to see if this call is a company or section requesting permission to move by testing the value of the

element of array MVARY referred to by the row and column of the call. If it is not a company or section, DECISION calls the appropriate move routine and schedules a RE.MV.STATE for the calling unit in 60 seconds and then returns from routine DECISION. If it is a company or section request, the logic goes on to test the restriction status of the company or section which is located in the TABLE array. If the company or section is not restricted, the appropriate movement routine is called and a message is created and sent informing the battalion of the unit move. If the unit is restricted from moving, the value of CREQST is checked to see if the unit has previously requested permission to move. If a previous request has occurred, a message is printed noting that fact and then the program returns from routine DECISION. If there has been no previous request for permission to move, the logic checks to see if the unit is on the same phase line as the rest of the units of the battalion. If the unit is farther to the rear than the battalion, a message is printed, and the program returns from routine DECISION. If the unit is on the battalion phase line the program checks to see if the unit has been given permission to move. If the unit has been given permission to move, the appropriate movement routine is called and a message is generated and sent informing the battalion of the unit move. If the unit does not have permission to move, a message is generated and sent to the battalion requesting permission to move. After this, the program exits from routine DECISION.

K. ROUTINE GEN.MOVE.DECISION.MSG

The SIMSCRIPT code for routine GEN.MOVE.DECISION.MSG is provided in Appendix N. It is called by all the movement

decision logic routines and it creates the message which is sent from one level to another by the flow of the communications logic. This routine first creates a message and then sets up an array called TEXT. A pointer to the TEXT array where the message's content is stored is saved as an attribute of the MESSAGE. After storing all the relevant information either as attributes of the MESSAGE or in the TEXT array, the program returns from routine GEN.MOVE.DECISION.MSG.

L. EVENT COMMO.ATTEMPT

The SIMSCRIPT code for event COMMO.ATTEMPT is provided in Appendix X. The flow diagram for the logic of event COMMO.ATTEMPT is provided in Figure 8. Event COMMO.ATTEMPT takes the messages which are created by the decision process and stochastically models their transmission. This event first checks both the sending and receiving UNIT/TANK to insure that both have radios. If either one does not have a radio, it prints an error message and stops the simulation. It then checks to be sure that both UNITs are on the same FMNET. If they are not, it prints an error message and stops the simulation. If they are, and the net is not busy, it sets the net to busy and calls routine TECH.COMMO which checks to see if communication between the two radios is technically possible. If the net is busy, it files the MESSAGE in the MAILBAG for that SUBSCRIBER and returns from event COMMO.ATTEMPT.

M. ROUTINE TECH.COMMO

The SIMSCRIPT code for routine TECH.COMMO is provided in

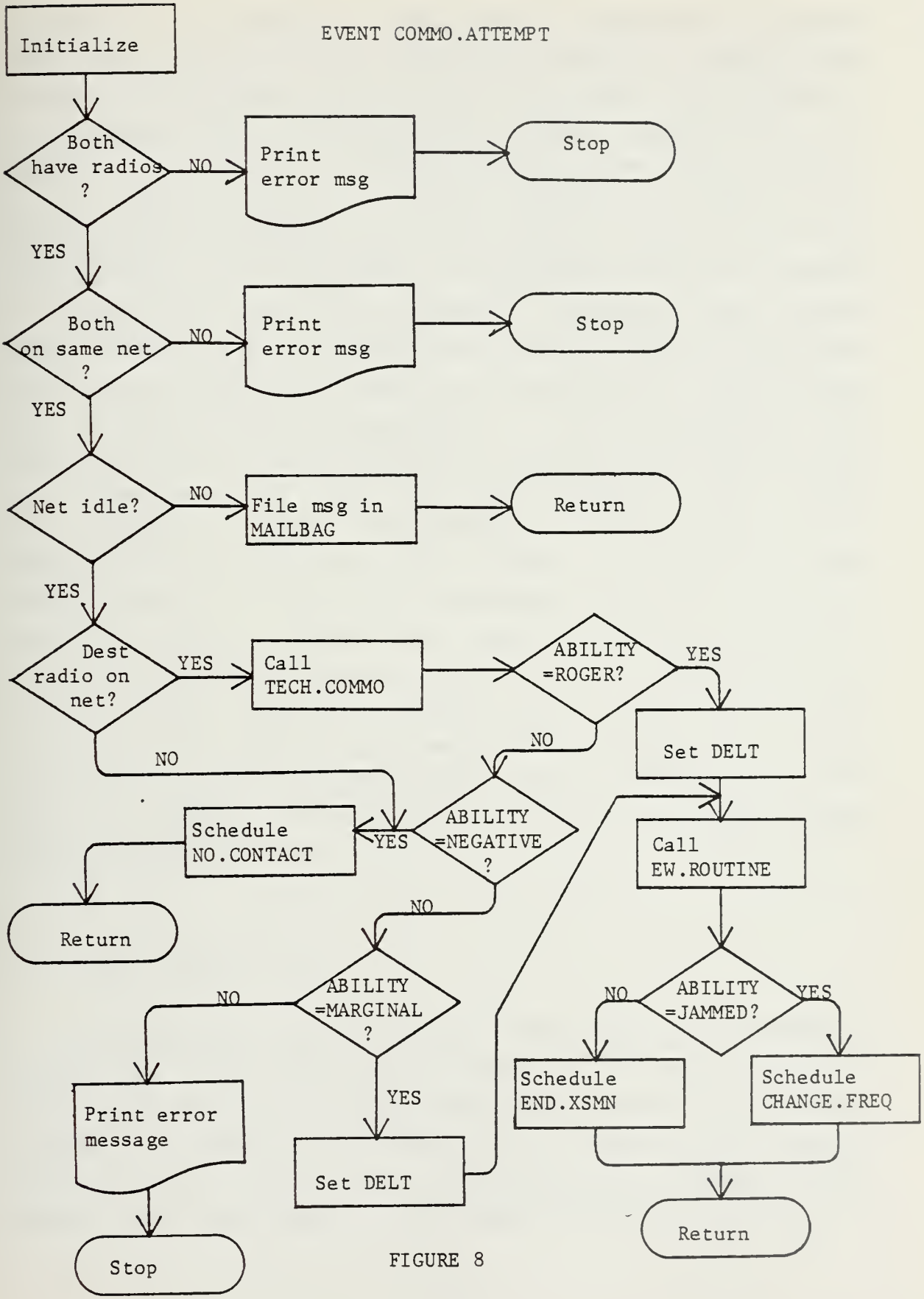

EVENT COMMO.ATTEMPT
Initialize
Both have radios ?
NO
Print error msg
Stop
YES
Both on same net ?
NO
Print error msg
Stop
YES
Net idle?
NO
File msg in MAILBAG
Return
YES
Dest radio on net?
YES
Call TECH.COMMO
ABILITY =ROGER?
YES
Set DELT
NO
NO
Schedule NO.CONTACT
YES
ABILITY =NEGATIVE ?
Call EW.ROUTINE
Return
NO
NO
ABILITY =MARGINAL ?
ABILITY =JAMMED?
NO
YES
Print error message
YES
Schedule END.XSMN
Schedule CHANGE.FREQ
Set DELT
Return
Stop

FIGURE 8

Appendix Y. Routine TECH.COMMO determines whether communication between two specific radios is technically possible. It returns one of four values for the ABILITY of the communication. It is either ROGER, meaning good, or MARGINAL, or JAMMED, or NEGATIVE meaning there was no answer by the distant station. If the ABILITY is JAMMED, event CHANGE.FREQ is scheduled and the program returns from event COMMO.ATTEMPT. If the ABILITY is NEGATIVE, event NO.CONTACT is scheduled and the program returns from event COMMO.ATTEMPT. If the ABILITY is either ROGER or MARGINAL, routine EW.ROUTINE is called to determine if the messagge will be jammed during transmission. If the EW.ROUTINE call indicates that the transmission is jammed, event CHANGE.FREQ is scheduled and the program returns from event COMMO.ATTEMPT. If the transmission is not jammed, event END.XSMN is scheduled and the program returns from event COMMO.ATTEMPT. It currently generates the four possible results by doing a random draw against the four integers 0, 1, 2, and 3. An initial procedure has been written to generate these values for ABILITY by a detailed algorithm based upon the radio characteristics, the terrain, and the locations of the two SUBSCRIBERs. This detailed algorithm will be enhanced and eventually it will replace the random draw currently in use.

N. EVENT CHANGE.FREQ

The SIMSCRIPT code for event CHANGE.FREQ is provided in Appendix Z. Event CHANGE.FREQ simulates the delay caused by having to change the net frequency as a result of its being jammed. It sets the attributes of the net and the calling radio to idle and then reschedules the COMMO.ATTEMPT. Bedause the scheduling of the CHANGE.FREQevent includes the

delay time that would be caused by changing the frequency, the COMMO.ATTEMPT is rescheduled "now." Also, because the probability of jamming is independent and there is no memory of the frequency, the frequency is not actually changed.

O. ROUTINE EW.ROUTINE

The SIMSCRIPT code for routine EW.ROUTINE is provided in Appendix AA. Routine EW.ROUTINE simulates the possibility of a transmission being detected and jammed by enemy action. At present, this is a random draw from 0, 1, 2, and 3 with equal probabilities. A draft module to model the direction finding and jamming activities explicitly has been written and it will be enhanced and will eventually replace the current uniform random draw.

P. EVENT NO.CONTACT

The SIMSCRIPT code for event NO.CONTACT is provided in Appendix BB. Event NO.CONTACT simulates the occurance of no response by the distant station. It sets the status of the net and the calling radio to idle and then calls routine SIEZE.NET before filing the current MESSAGE in the MAILBAG of the calling radio.

Q. ROUTINE SIEZE.NET

The SIMSCRIPT code for routine SIEZE.NET is provided in Appendix CC. Routine SIEZE.NET does a random draw against all the SUBSCRIBERs on a specific FMNET which have MESSAGESs waiting in their MAILBAGs to determine which of them will

get the net which has been left idle as a result of the occurance of either a NO.CONTACT or END.XSMN event. It then removes that MESSAGE from its MAILBAG and schedules a COMMO.ATTEMPT "now."

R. EVENT END.XSMN

The SIMSCRIPT code for event END.XSMN is provided in Appendix DD. The flow diagram for the logic of event END.XSMN is provided in Figure 9. Event END.XSMN simulates the arrival of the MESSAGE at the distant station. It gathers the message identification data into global variables and then destroys the MESSAGE. It then tests the value of the the destination code of the message to determine which level of the logic should handle the MESSAGE. This is possible since every MESSAGE has both a type and a destination code and because the text of the message where the data for the decision process is stored is set up as a separate variable length record for which only a pointer is stored in the actual MESSAGE. This means that each type message can have a different length text, and the contents can be generated separately from the actual fixed format portion of the MESSAGE. The attributes of each MESSAGE are passed as arguments through the communications process. A diagram of the pointer links used in the communications logic is provided in Figure 2. Based upon the destination code, one of the message distribution routines, CO.MSG, BN.MSG, BDE.MSG, or DIV.MSG is called. It then releases the text where the MESSAGE data was stored and sets the status of the calling radio, the receiving radio, and the FMNET to idle. It then checks the simulation time using the FORTRAN routine MYTIME to see if the allocated CPU time for the execution of the program is about to run out.

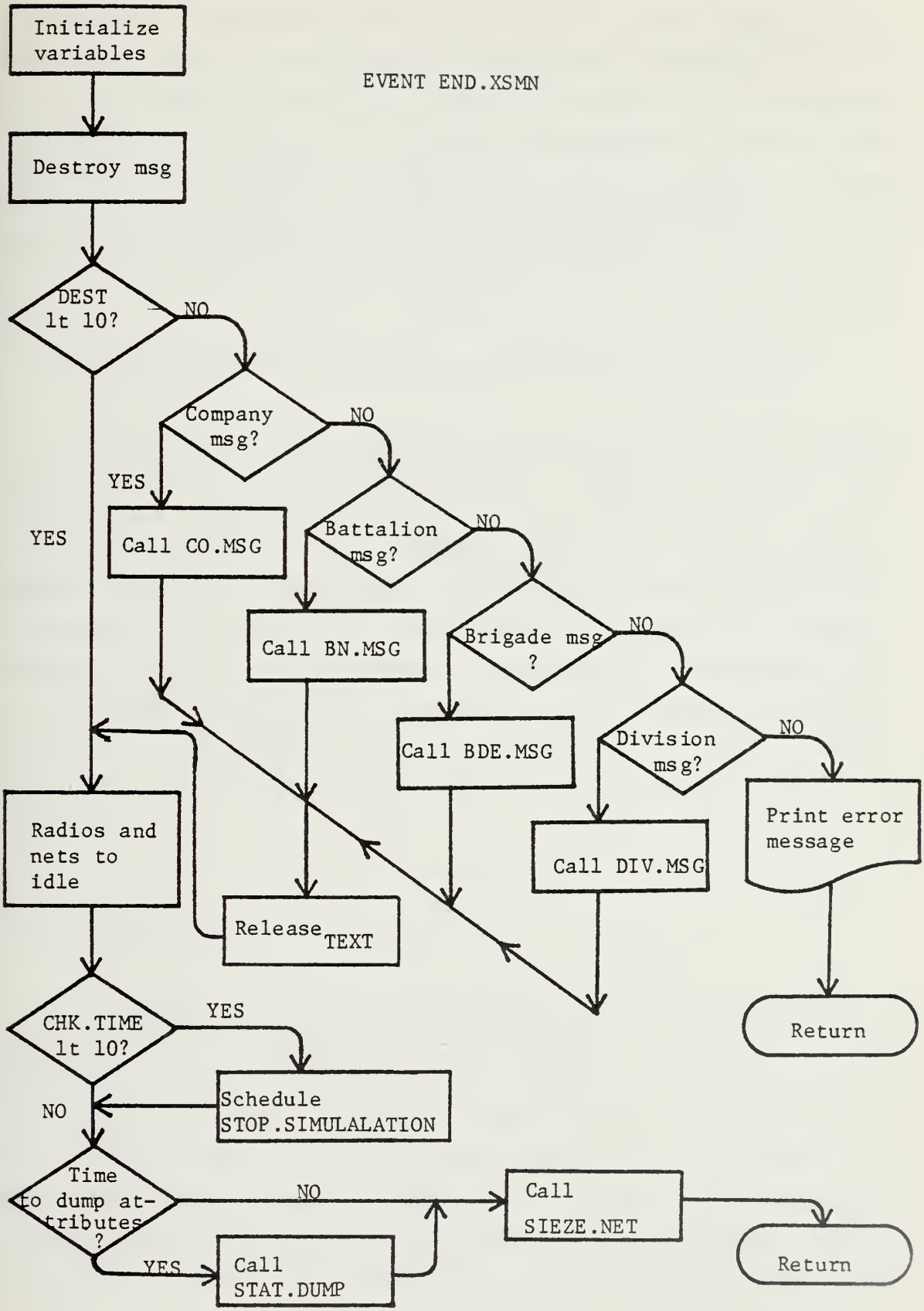

EVENT END.XSMN
Initialize variables
Destroy msg
DEST lt 10?
NO
YES
Company msg?
NO
YES
Call CO.MSG
Battalion msg?
NO
Call BN.MSG
Brigade msg ?
NO
Call BDE.MSG
Division msg?
NO
Call DIV.MSG
Print error message
Radios and nets to idle
Release TEXT
Return
CHK.TIME lt 10?
YES
NO
Schedule STOP.SIMULALATION
Time to dump attributes ?
NO
YES
Call STAT.DUMP
Call SIEZE.NET
Return

FIGURE 9

If less than 10 seconds of time remain, a STOP.SIMULATION is scheduled "now." Regardless of the time remaining, the time since the last printout of the attributes of the commanders is checked and if it is has been approximately (within 10%) COM.DATA.DUMP seconds since the last print, routine STAT.DUMP is called. Finally, routine SIEZE.NET is called and the program returns from event END.XSMN.

S. ROUTINES CO.MSG, BN.MSG, BDE.MSG, and DIV.MSG

The SIMSCRIPT code for all of these routines is provided in Appendix EE. Routines CO.MSG, BN.MSG, BDE.MSG, and DIV.MSG all act as distribution activities which test the value of the type of the MESSAGE and call the appropriate logic routine to handle that MESSAGE. In future versions of the model there will be many different types of messages corresponding to the different functions to be accomplished by the messages such as calling for air support, artillery fires, or logistics support. Routines DEC.CO, DEC.BN, DEC.BDE, and DEC.DIV are all called from these .MSG routines.

T. ROUTINE DEC.CO

The SIMSCRIPT code for routine DEC.CO is provided in Appendix I. In addition, a flow diagram of the logic for routine DEC.CO is provided in Figure 4. Routine DEC.CO handles the movement decision logic at the company level. It is called from routine CO.MSG based upon the value of the MSG.TYPE attribute of the MESSAGE. It first stores the text of the MESSAGE in global variables and then tests for the specific type of the MESSAGE. The MESSAGE types are

delineated in the PREAMBLE as global "DEFINE TO MEAN" statements. Based upon the value of the MSG.TYPE, several different actions are taken. If the MESSAGE restricts the company from moving, the company's permission attribute is set to zero, a line noting that the company has been ordered not to move is printed and the program returns. If the MESSAGE gives the company permission to move, the company's permission attribute is set to one and a line noting that the company has been given permission to move is printed before further processing of the MESSAGE is attempted. If the MESSSAGE orders the company to move, the company's permission attribute is set to one, a line noting that the company has been ordered to move is printed, and then movement of each TANK in the company is initiated. Routine AIR.COMMO and routine CO.GO are called for each TANK and a RE.MV.STATE is scheduled for the company in 60 seconds. At this point, the value of ORDER is set to two and routine EXIT is called prior to the return from the DEC.CO routine. If the message falls past the above described procedures which provide returns, it then causes the location of the company to be determined. Then it checks to see if the company has been given permission to move. If it has, ORDER is set to one. If not, ORDER is not reset from the value it has on entry to this section of code. Then routine EXIT is called and the program returns.

U. ROUTINE DEC.BN

The SIMSCRIPT code for routine DEC.BN is provided in Appendix J. A flow diagram of the logic for routine DEC.BN is provided in Figure 5. This routine handles the movement decision logic at the battalion level. It is called from routine BN.MSG based upon the value of the MSG.TYPE

attribute of the MESSAGE being processed. It stores the text of the MESSAGE in global variables and then tests for the specific type of the MESSAGE. If the MESSAGE is a request to move from a company which has not previously requested permission to move, the value of COWT is added to BNCUR and the request count of the company is set to one before any furthur processing is attempted. It then checks to see if the MESSAGE is a notification of a company or section move. If it is a company movement notification, a line noting that fact is printed and then a MESSAGE is generated and sent to inform the brigade that a company has moved. If it is a section movement notification, a line noting that fact is printed and the program returns. If the MESSAGE is an order to the battalion to move, the battalion's permission attribute is set to one and the BNGO value is added toe the BNCUR value prior to further processing. If the MESSAGE is permission for the battalion to move, the battalion's permission attribute is set to one and the BNCUR value is set equal to the BNLO threshold. If the MESSAGE orders the battalion not to move, the battalion's permission attribute is set to zero and the program returns without any further processing. When a MESSAGE reaches this point, the originator and addressee are interchanged to facilitate subsequent responses. At this point, the permission status of the battalion is checked. If it is a one, the battalion has permission to move and subsequent tests are done to see if the BNCUR value has exceeded the BNLO or the BNGO thresholds. First, the BNGO bound is checked and if it has been exceeded, a MESSAGE is generated and sent to each company in the battalion ordering the companies to move. Also, a line is printed stating that the companies have been ordered to move and a MESSAGE is generated and sent informing the brigade that the companies have all been ordered to move. If the BNLO threshold has

been exceeded, each company is sent a MESSAGE which gives it permission to move and a line is printed noting that fact. Also, a MESSAGE is sent to the brigade with the information that all the companies have been given permission to move. If the BNCUR value doesn't exceed BNLO, the company is sent a MESSAGE ordering it not to move and a line is printed noting this action. If the battalion is restricted from moving and the BNCUR value exceeds the BNLO bound, the battalion sends a MESSAGE to the brigade requesting permission to move. Finally, if the battalion is restricted and the BNCUR value does not exceed the BNLO bound, the battalion sends a MESSAGE to the originating company ordering it not to move. Then the program returns from routine DEC.BN.

V. ROUTINE DEC.BDE

The SIMSCRIPT code for routine DEC.BDE is provided in Appendix K. A flow diagram of the logic for routine DEC.BDE is provided in Figure 6. This routine handles the movement decision logic at the brigade level. It is called from routine BDE.MSG based upon the value of the MSG.TYPE of the MESSAGE being processed. The logic of this routine is exactly symmetric to the logic in routine DEC.BN with battalion, brigade, and division substituted for company, battalion, and brigade respectively. The attributes used must be those for the brigade vice those for the battalion.

W. ROUTINE DEC.DIV

The SIMSCRIPT code for routine DEC.DIV is provided in Appendix L. A flow diagram for the logic of routine DEC.DIV

is provided in Figure 7. This routine handles the movement decision logic at the division level. It is called from routine DIV.MSG based upon the value of the MSG.TYPE of the MESSAGE being processed. The logic of this routine is the same as that at the battalion and brigade level except that it is somewhat truncated since no messages are sent to a higher command. The attributes used must be those for the division level and brigade and division must be substituted for battalion and brigade.

X. EVENT DUMP.MAILBAG

The SIMSCRIPT code for event DUMP.MAILBAG is provided in Appendix FF. Event DUMP.MAILBAG simulates the event of going through all the MAIL.BAGs of all the SUBSCRIBERs and checking to see if the time of the simulation has exceeded the LST.SEND.TIME for any of the MESSAGEs in any of the MAILBAGs. Each MESSAGE which is too old is removed from its MAILBAG and routine ABORT.MSG is called for it. Event DUMP.MAILBAG then reschedules itself in 600 seconds.

Y. ROUTINE ABORT.MSG

The SIMSCRIPT code for routine ABORT.MSG is provided in Appendix GG. Routine ABORT.MSG simulates the action of sending a MESSAGE by another means if it gets to be a certain age rather than to continue to wait for the transmission. Currently, it simply destroys the MESSAGE, but, it is planned to upgrade this routine so that it will simulate the transmission by courier or some other means explicitly.

Z. EVENT MSG.GEN

The SIMSCRIPT code for event MSG.GEN is provided in Appendix HH. Event MSG.GEN simulates the background noise messages which monopolize the communications nets and with which the movement decision messages must compete for time on the nets. It generates messages at random on all the simulated nets. It first checks to insure there are at least two SUBSCRIBERs on the net. Then it selects at random one of these SUBSCRIBERs to be the originator of the MESSAGE and another of them to be the destination of the MESSAGE. It then creates the MESSAGE, sets its attributes, increments the NXT.MSG.NO for the originating station, and schedules the COMMO.ATTEMPT to send the MESSAGE. It then selects at random the next FMNET on which a "noise" MESSAGE will be sent and reschedules itself to generate the MESSAGE on that net.

VII. COMMUNICATIONS MODULE PARAMETERIZATION

There are several features of the communications parameterization process which warrant detailed examination and they are covered in the paragraphs below.

The communications between any two receivers in the same net depends on several variables. One of these variables is the ability of the radios to send a signal of sufficient strength so that it is greater than the squelch threshhold of the distant receiver. This is a function of radio line-of-sight, polarity of the antennas, power output of the radios, and many other factors. In the present implementation of communications, this capability is modeled as a uniform random draw against an integer variable between 0 and 3. An ability of 0 means the communication is feasible. An ability of 1 means the communication is marginal and requires two complete transmissions to get the message through. The effect of this is to tie up the net for twice as long as if the ability had been 0. An ability of 2 means the distant station does not answer. An ability of 3 means that successful jamming was encountered and a frequency change is scheduled prior to attempting to send the message again. Once the ability is determined by routine TECH.COMMO, there is another factor which must be considered when the message is actually being transmitted, the ability of the enemy to selectively detect and jam the communications. In the current version of the communications model, this ability is modeled as a uniform distribution with a 1/4 probability of jamming the transmission and a 3/4 probability of no jamming. In the final version of the communications model the distribution of the jamming will be a user input which can be any

suitably defined distribution function. In addition, it is anticipated that a module will be used to calculate the transmission loss using the STAR LOS (line of sight) routine, the power and transmission characteristics of the radios, and the data on the antennas. This transmission loss will be translated into a 0, 1, 2, or 3 to give a clear, a partial, a blocked or a jammed transmission respectively.

The ABORT.MSG routine is currently used to drop old messages from the lists of those waiting to be sent. In subsequent revisions of this logic, it is anticipated that an alternate method of delivery for these messages will be developed, and they will be sent by this alternate means if they get to be a certain age. Currently, they are simply destroyed if they reach the designated age without being transmitted. The age at which the destruction is invoked is a user imput.

The user has two important parameters at his disposal to assist him in debugging any problems in the communications code or the input data. The first of these, COM.PRINT, determines which of the builtin messages are printed out by the program during execution. There are several levels for this parameter. It is tested for being greater than 10, 15, 20, and 25 at various points in the logic. The larger the value of this parameter used, the more detailed will be the printout of data during the execution. The second parameter, COM.DATA.DUMP, determines the amount of simulated time which is allowed to pass before a dump of the attributes of the company,battalion, brigade, and division commanders is executed. This attribute dump enables the user to check to be sure that the correct weights are being used for the units and that the request and permission attributes of the commanders are being properly set by the program. Both of these parameters are read in from cards at the beginning of the STAR BIG.MAIN routine.

VIII. COMMUNICATIONS MODULE INPUT REQUIREMENTS

The input requirements for the communications module fall into several categories based upon which module reads them in and uses them. The folowing descriptions are given in the same order as they occur when executing the model and are broken down into sections by routine. All read statements use the free form read with at least one blank separating variables.

BIG.MAIN

A. Read COM.PRINT
   COM.PRINT
   This integer variable determines the level of detail which is printed out during execution of the model. When set to zero, all of the print statements are turned off. The major break points in the printout decision logic are set at 10, 15, 20, and 25. Any COM.PRINT value larger than these levels causes all those levels below it to be turned on.

B. Read COM.DATA.DUMP
   COM.DATA.DUMP
   This real variable determines how often the values of the attributes of the unit commanders are printed out. For example, if read in as 600.0, approximately every 600 seconds of simulation time the attributes will be printed.

BUILDNETS

A. Read NONETS,NORELAY
   NONETS
   This integer variable specifies the total number of FM nets which are to be simulated.
   NORELAY
   This integer variable specifies the total number of relays to be simulated.

B. Read NFMN, NRSUB, NALTFR
   NFMN
   This integer variable specifies the number designator of the ith radio net.
   NRSUB
   This integer variable specifies the number of alternate frequencies assigned to the ith radio net.
   NALTFR
   This integer variable specifies the number of alternate

freqiencies assigned to the ith radio net.

C. Read NTCK and NPRI
NTCK
This integer variable is a check to insure that the correct frequency is assigned to each net. It must be the same as NFMN from B. above to avoid an error.
NPRI
This integer variable is the primary frequency assigned to the ith net.

D. Read TKHOLD
TKHOLD
This integer variable is the number designator of the UNIT/TANK which belongs to the SUBSCRIBER created in this loop. This SUBSCRIBER will be a node in the net designated by NTCK and NFMN. All the SUBSCRIBER number designators are read in and the SUBSCRIBERs filed in the net before going on to read statement E.

E. Read NETNO
NETNO
This integer variable must equal NFMN to avoid an error.

F. Read TKALT
TKALT
This integer variable has the alternate frequencies of net NFMN read into it one at a time. All these alternate frequencies are read and stored in the ragged array FM.PUSHES in a loop prior to going to the next read statement B.

COMMGEAR

A. Read NRADIO.TANKS
NRADIO.TANKS
This integer variable specifies the number of tanks in the simulation which will have radio equipment.

B. Read TKNO, NORAD
TKNO
This integer variable specifies the number designator of the TANK/UNIT which will have communications equipment.
NORAD
This integer variable specifies the number of sets of radio equipment (RT.CONFIG's) the TANK/UNIT will have.

C. Read RAD.TYPE(RT.CONFIG) and MODE.OPERATION(RT.CONFIG)
RAD.TYPE(RT.CONFIG)
This integer attribute of RT.CONFIG specifies the type of radio in use. At present these are dummy types and have no real significance.
MODE.OPERATION(RT.CONFIG)
This integer attribute of RT. CONFIG specifies the mode of operation of the radio. At present these are dummy modes and have no real significance.

D. Read ANT.TYPE(RT.CONFIG)
ANT.TYPE(RT.CONFIG)
This integer attribute of RT. CONFIG specifies the type of antenna being used for this radio set. If this number is less than zero, the antenna is directional,

and since there are no provisions for this type in the rest of the program at this time, this causes the program to print a message concerning directional antennas and stop.

E. Read REM.ANT(RT.CONFIG)
REM.ANT(RT.CONFIG)
This integer attribute of RT.CONFIG specifies whether or not the antenna is remoted from the radio. If the value is not zero, the antenna is remoted, and since there is no provision for this in the rest of the program, it causes the program to print a message concerning remoted antennas and stop.

INITIALIZE

A. Read PAR00, PAR01, ... PARxx
PARxx
These are integer parameters used for generating random numbers using the SIMSCRIPT random number calls. The value of xx should not exceed 49, and each should be different.

B. Read PAR50, PAR51, ... PARyy
PARyy
These are real parameters which are used for random number generation. The yy value should be larger than 49, and each yy must be unique.

C. Read CO.LO.BD and CO.UP.BD
CO.LO.BD
This integer variable is the lower bound of the destination code for messages being sent to the company level.
CO.UP.BD
This integer variable is the upper bound of the destination code for messages being sent to the company level.

D. Read BN.LO.BD and BN.UP.BD
BN.LO.BD
This integer variable is the lower bound of the destination code for messages being sent to the battalion level.
BN.UP.BD
This integer variable is the upper bound of the destination code for messages being sent to the battalion level.

E. Read BDE.LO.BD and BDE.UP.BD
BDE.LO.BD
This integer variable is the lower bound of the destination code for messages being sent to the brigade level.
BDE.UP.BD
This integer variable is the upper bound of the destination code for messages being sent to the brigade level.

F. Read DIV.LO.BD and DIV.UP.BD
DIV.LO.BD This integer variable is the lower bound of the destination code for messages being sent to the division level.
DIV.UP.BD

This integer variable is the upper bound of the destination code for messages being sent to the division level.

IX. FUTURE MODEL ENHANCEMENETS

The model of communications described in this document represents a good foundation for developing those additional communications-related modules required to enhance the realism of the STAR Model. The structure of this model is sufficiently flexible to handle most of the communications requirements envisioned for inclusion in STAR.

Obviously, there is still much to be done. A few of the more important areas for future work are identified in this chapter.

Enhancement of the red interception and jamming capability module initially developed by Cpt. Haislip is high on the list of significant actions which will have a marked effect on the realism of the current model since it incorporates a call to a jamming routine for which the user supplies parameters.

In addition to the red electronic warfare capabilities, the blue force EW assets and doctrine must be evaluated and modeled to provide a balanced picture of the impact of EW on the model.

The play of relays for the FM nets, radio wire integration, radio teletype HF nets, and directional antennas should be considered for inclusion in the model. It may be that some of these do not provide sufficient gains in realism to justify their being included, but they should be studied.

Since the STAR model is headed for the goal of modeling a blue brigade under attack by a red division, the multichannel radio nets within the brigade boundary and those going back to the corps level need to be studied and considered for inclusion in the model. These nets represent

a large proportion of the communications assets in the brigade area and should be included in the model in some manner. Additionally, as more and more of the logistics and support functions are included in the model, the need to model communications to entities other than the unit commanders will increase. This means modeling at least part of the communications network down to the individual instrument or line where these support people are located.

Finally, the whole area of Command, Control, Communications, and Intelligence needs to be integrated in some way with the tactical decision logic in order to take advantage of the information which can be gained from the intelligence network.

APPENDIX A

STAR ROUTINES, EVENTS, AND ARRAYS

The following routines, events, and arrays are key elements in the existing STAR movement decision logic.

ROUTINES

Action
: This routine calls the movement decision routine and takes action based on the value of the order returned to initiate movement of units in conjunction with the leave logic.

Bn.go
: This routine initiates movement of a blue battalion from its current position.

Bug.chk
: This routine checks to see if a unit should move as a result of being too close to an enemy unit and calls the movement decision routine if required.

Co.go
: This routine initiates movement of a blue company from its current position.

Decision
: This routine is called by routine ACTION or routine BUG.CHK. It updates the values of CREQST, BREQST, BNCUR, and BDECUR and checks the attributes of a unit and the values stored in the arrays TABLE, BNCORD, and COCORD to determine if the unit is allowed to perform a desired movement. It causes units to move if the BNCUR or BDECUR values exceed the LO or GO bounds for the battalion or the brigade.

EVENTS

Phaz.chk
: This event determines whether the current phase line is still occupied. If it is still occupied, the event reschedules itself. If it isn't occupied, the event removes the battalion commander from the BRIGADE (set) and calls routine COORD.SET.

Re.mv.state
: This event checks to see if units have arrived at their new locations.

Table

A diagram of the organization of this array is provided in Figure 10. This three dimensional array has a plane for each blue maneuver unit and seven rows for each plane. The first six rows correspond to monitored weapons systems for the unit and the seventh corresponds to the unit as a whole. Each weapon system row has 4 plus 3*NPRI columns where NPRI is the number of attrition level actions planned for that system. Column 1 contains the system code in the first 6 rows and the boundary range in the seventh row. If no enemy units are within this range, the unit will not move off its position unless ordered to do so. Column 2 contains the weapon code in the first six rows and the range within which all enemy units are used for computing the force ratio in the seventh row. Column 3 contains the closing range within which an enemy firing at a system causes it to request permission to move off its position. Column 4 contains the code for whether a system or unit is restricted from moving or is free to move at will. The remaining columns are in groups of 3 with the first being an attrition level, the second being the force ratio, and the third being the code for the action to be taken if that attrition level and force ratio are exceeded.

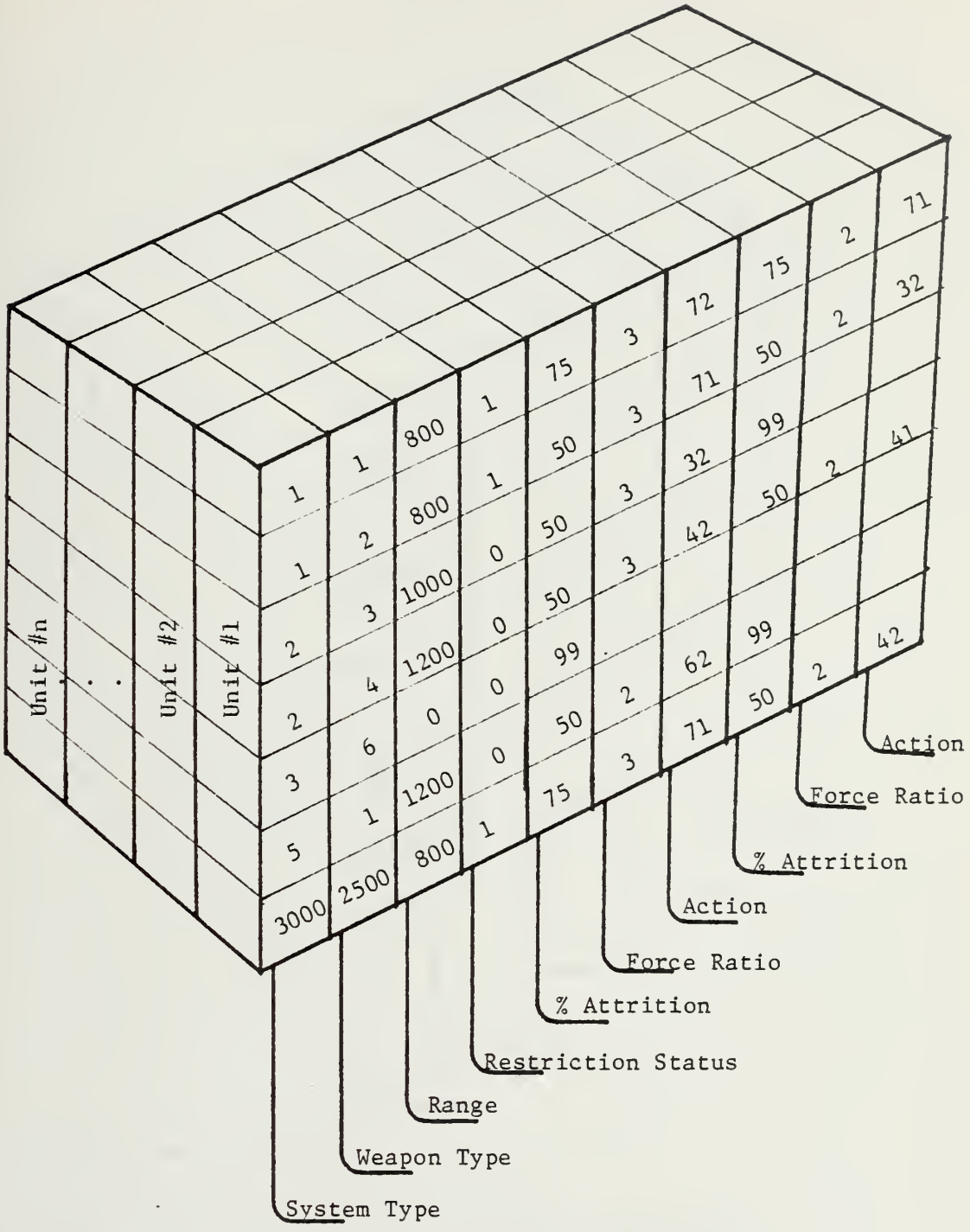
Bncord

A diagram of the organization of this array is provided in Figure 11. This three dimensional array has a plane for each blue battalion, a row for each phase line, and five columns. The first column contains BMSN, the code for whether or not the battalion has permission to move off this coordination line. The second column contains BNCUR, the sum of the weights of the companies which have requested permission to move off their current coordination lines. The third column contains BNWT, the tactical weight of the battalion on this coordination line. The fourth column contains BNLO, a lower bound which if exceeded by BNCUR causes the battalion to give all the companies permission to move. The fifth column contains BNGO, a lower bound which if exceeded by BNCUR causes the Battalion to order all companies to move.

Cocord

A diagram of this array is provided in Figure 12. This three dimensional array has a plane for each blue company unit, a row for each coordination line, and two columns, The first column contains CMSN, the code for whether or not the company has permission to move off its current coordination line. The second column contains COWT, the tactical weight of the company on this coordination line.

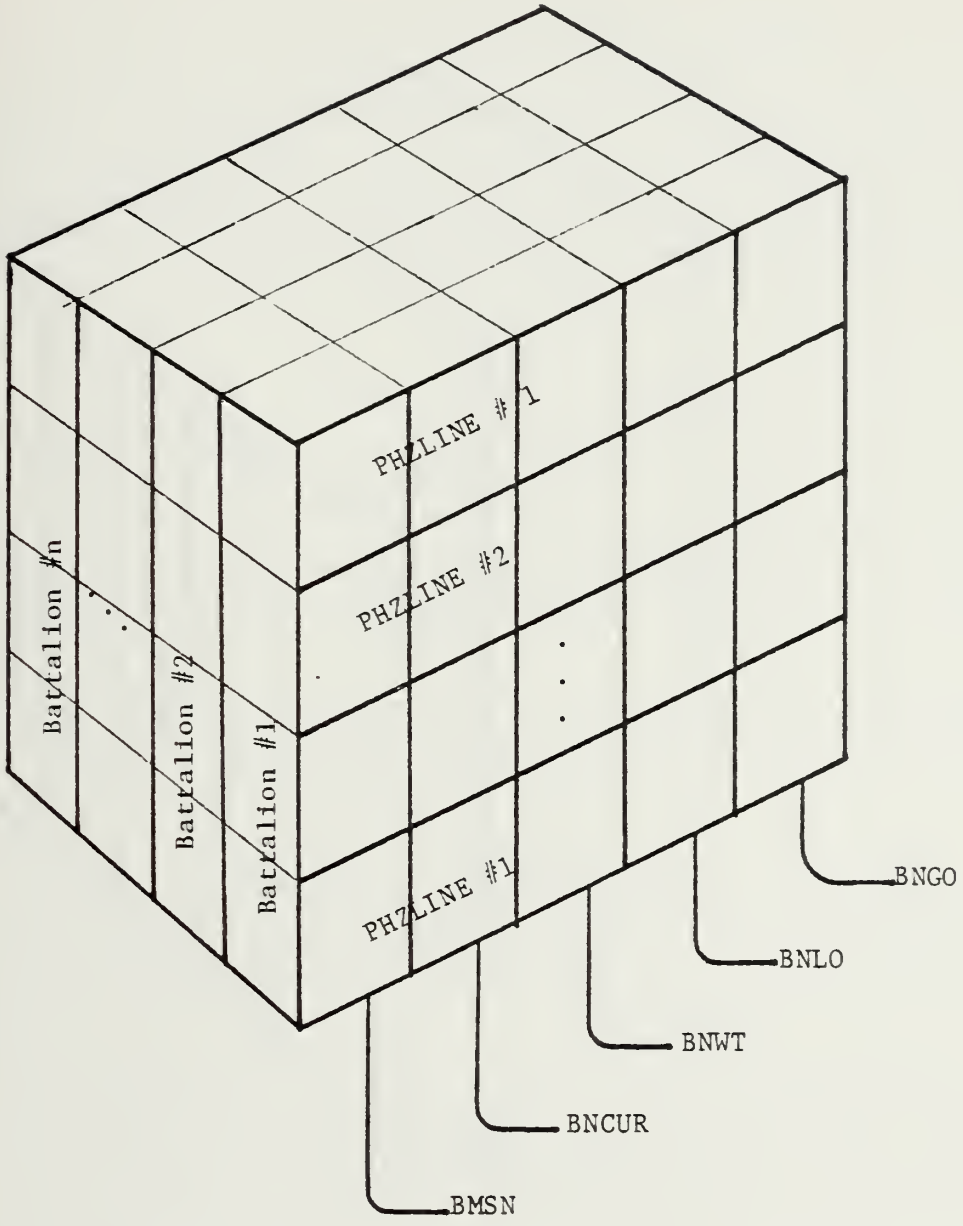
TABLE DIAGRAM



A plane for each blue maneuver unit
A column in each plane for each of the above weapon system attributes
A row in each plane for each of up to seven weapon systems

FIGURE 10

BNCORD DIAGRAM



A plane for each battalion

A row in each plane for each phase line

A column in each plane for each of the five attributes

FIGURE 11

COCORD DIAGRAM

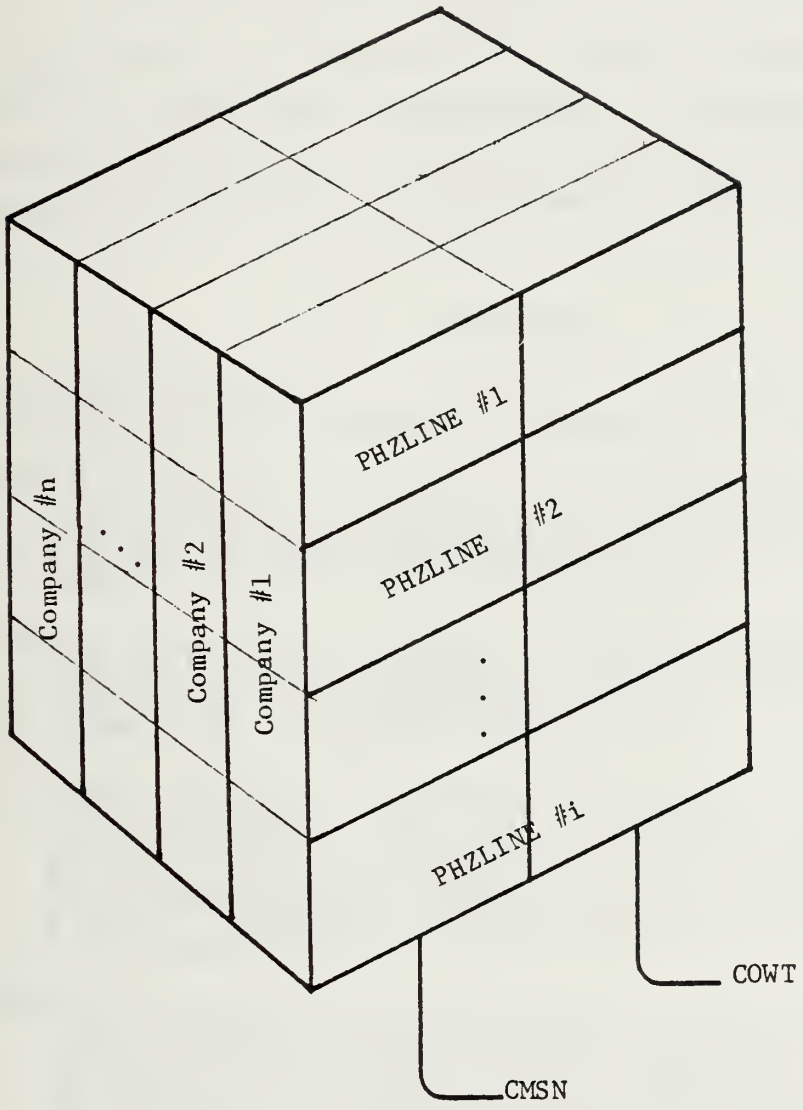


FIGURE 12

APPENDIX B

COMMUNICATIONS ROUTINES AND EVENTS

The communications model uses the following routines and events to model the transmission of messages between the decision levels. The decision process is based upon the information contained in the messages and their texts.

ROUTINES

Abort.msg(tank,msg)
This routine destroys a message if it gets too old.

Bde.msg
This routine is called by event END.XSMN whenver a brigade-level message is encountered. This routine in turn calls the appropriate logic routine to handle the message based on the message type.

Bn.msg
This routine is called by event END.XSMN whenever a battalion-level message is encountered. This routine in turn calls the appropriate logic routine to handle the message based on the message type.

Bnettbl
This routine is called by routine COM.MAIN during initialization of the program. It builds two two-dimensional tables or ragged arrays. The first, NETTBL, stores the subscripts of the subscribers of the Ith radio net in row I of the array. The second, RPOINT, stores in its Ith row the address pointers of the subscribers in the Ith radio net.

Buildnets
This routine is called by routine COM.MAIN during initialization of the program. It reads in the number of radio nets, the number of relays, the subscribers in each net, and the alternate frequencies for each net. It creates the FMNETS and files them in the ETHER and also creates the SUBSCRIBER's and files them in the CEOI.LIST of the FMNET to which they belong.

Checknets
This routine is called by routine COM.MAIN during initialization of the program. It cycles through each FMNET and prints the number of the net, the primary frequency of the net, the number of alternate frequencies, the alternate frequencies, and the number of SUBSCRIBER's in the net. This is primarily a data debugging facility.

Co.msg

This routine is called by event END.XSMN whenever a company-level message is encountered. This routine in turn calls the appropriate logic routine to handle the message based on the message type.

Com.main
This routine calls the routines which initialize the communications portion of the program. It then schedules the DUMP.MAILBAG and MSG.GEN(FMNET) events and returns control to the SIMSCRIPT II.5 scheduler.

Commcheck
This routine is called by routine COM.MAIN during initialization of the program. It cycles through every TANK in BLUE.ALIVE and prints out the communications gear which has been assigned to each TANK, the location of each TANK, the mode of operation of each radio, and the type of antenna used by each radio. This is primarily a data debugging facility.

Commgear
This routine is called by routine COM.MAIN during initialization of the program. It reads the number of each TANK which is to have communications capability and the number of radios each TANK is to have. It then creates a MYSET for that TANK which is a set containing pointers to all the RT.CONFIG's (radios) owned by that TANK. It creates the required number of RT.CONFIG's for that TANK and files them in RAD.LIST of MYSET. It reads the radio type, the mode of operation of the radio, and the antenna type used by the radio and sets these attributes of each of the RT.CONFIG's created. After creating all of the radios, the routine sets the next message number of each tank to n001, where n is the number of the TANK. It then places the equipment in the appropriate net, and prints out a matrix of the TANK subscript and the address pointers for the TANK, the MYSET, the RT.CONFIG, and the SUBSCRIBER for each TANK in each FM net in the ETHER. This listing is primarily a debugging facility.

Dec.bde
This routine handles the movement decision at the brigade level. It checks to see if a battalion should move or be given permission to move and if so, it causes the appropriate message to be generated and schedules the COMMO.ATTEMPT to the battalion.

Dec.bn
This routine handles the movement decision at the battalion level. It causes messages to be generated and schedules COMMO.ATTEMPT's to both the company level and the brigade level.

Dec.co
This routine initiates movement of the company from its current position by calling the CO.GO routine if authorized by the text of the message.

Dec.div
This routine handles the movement decision logic at the division level. It causes messages to be generated and schedules COMMO.ATTEMPT's to the brigade level.

Decision(row,col,t)
This routine does the preliminary checks to determine if a company needs permission to move and if so, it

causes a message to be generated and schedules a COMMO.ATTEMPT to the battalion. If permission is not required, it causes the unit to begin movement.

Div.msg
This routine is called by the END.XSMN event whenever a division-level message is encountered. This routine then calls the appropriate logic routine to handle the message based on the message type.

Ew.routine
This routine is called by the COMMO.ATTEMPT event whenever a message is being placed on the net to determine if the message will be jammed. If the message is jammed, event CHANGE.FREQ is scheduled and executed prior to allowing another attempt to send the message.

Exit(order,t,crit,p.z.time,flag)
This routine is used as an escape from the decision process if permission is not required for a company to move from its current position.

Gen.move.decision.msg(pharow,order,t,crit,p.z.time) yielding msg
This routine produces the movement request and order messages, assigns values to the message text variables, and passes a pointer to the message back to the calling routine.

Initialize
This routine is called by routine COM.MAIN during the initialization of the communications portion of the program. This routine reads the parameters for the distributions used in scheduling the communications events. It also calls routines SSTAT.DUMP and STAT.DUMP.

Sieze.net(callnet)
Upon termination of a message on any of the FMNET's, this routine checks that FMNET to see if there are any messages which have been saved and need to be transmitted over it. If so, it selects one at random and schedules the COMMO.ATTEMPT for that message.

Sstat.dump.
This routine is called by routine INITIALIZE during the initialization of the program. This routine prints out the values of the attributes of the brigade, battalion, and company commanders which are used for movement coordination.

Stat.dump
This routine is called by routine INITIALIZE during the initialization of the program and by routine SNAP.R if the program should fail. This routine lists the attributes of each company commander, battalion commander, brigade commander, and division commander.

Tech.commo(callrt,recrt) yielding ability
This routine is used to determine how good communication is between the origin and destination stations attempting to pass and receive each message. A message can be one of four types: 1) normal transmission, 2) marginal transmission (It takes twice as long as a normal transmission.), 3) no response (The distant station does not answer.), and 4) jammed transmission (The sender experiences jamming as soon as

he enters the net and immediately schedules a CHANGE.FREQ as a result.).

Xy.antenna(rt.config) yielding xt, yt, and zt
This routine determines the x, y, and z coordinate locations of remoted antennas. It is called by routine COMMGEAR during the initialization phase of the program.

EVENTS

Change.freq(callrt,callnet,msg)
This event is called when the attempted transmission is jammed. It "changes" the tranmitting frequency of the net. In fact, the frequency isn't changed since there is no memory property for the jamming routine and each test to see if a MESSAGE is jammed is an independent trial. The frequency could be changed by a quite simple algorithm, but since this isn't required, another COMMO.ATTEMPT is scheduled after a suitable wait representing the time required to change the frequency.

Commo.attempt(orig,msg)
This event simulates the process of acquiring communications with a distant station. It checks to insure that both UNIT's/TANK's have radios, that they are both on the same net, that communication is technically feasible, that the net is not busy, and that the distant station responds to the call. It files the MESSAGE in a MAILBAG if it can't be transmitted and schedules another COMMO.ATTEMPT at a later time. It also sets the busy-state of the FMNET to busy.

Dump.mailbag
This event checks every station in every net for messages waiting to be transmitted which have a LST.SEND.TIME attribute less than simulation time. When it finds a MESSAGE which satisfies this condition, it removes the MESSAGE from the MAILBAG of those waiting for transmission and calls ABORT.MSG which destroys the MESSAGE.

End.xsmn(callrt,recrt,callnet,msg)
This event is scheduled when the COMMO.ATTEMPT for each MESSAGE occurs. It is the current simulated time plus the length of the MESSAGE. When this event occurs, the MESSAGE content is examined and based upon the destination code, one of the DEC. routines is called to handle the decision process. This event also sets the busy-state of the FMNET to idle.

Msg.gen(fmnet)
This event generates "background noise" messages on the nets to simulate the other traffic with which the movement decision messages have to compete for time on the net.

No.contact(callrt,callnet,msg)
This event simulates a lack of response by the distant station by setting the busy-state of the net to idle so that other messages can be passed. It also files the MESSAGE in a MAILBAG for future transmission.

APPENDIX C

COMMUNICATIONS GLOBAL VARIABLES

INTEGER VARIABLES

Addr.store
This is a temporary storage location for the address to which a MESSAGE will be sent. It is used to pass the address to the message generation routine rather than increase the number of parameters explicitly passed to the routine.

Adrsee
This is a temporary location used in the decision logic to store the addressee of an incoming MESSAGE. It is loaded by the END.XSMN event just prior to the destruction of the MESSAGE.

Bbde
This variable is one that was added to those used in the basic STAR model. It contains the value read in for the number of blue brigades to be played.

Bde.lo.bd
This is an input parameter set by the user as the lower bound of the DEST.CODE of a MESSAGE that will be sent to the brigade.

Bde.up.bd
This is an input parameter set by the user as the upper bound of the DEST.CODE of a MESSAGE which will be sent to the brigade.

Bn.lo.bd
Same as BDE.LO.BD but for the battalion level.

Bn.up.bd
Same as BDE.UP.BD but for the battalion level.

Co.lo.bd
Same as BDE.LO.BD but for the company level.

Co.up.bd
Same as BDE.UP.BD but for the company level.

Com.print
This input parameter determines what information is printed during an execution of the model. The larger COM.PRINT is, the more detailed the printout becomes. When set to zero, the execution printout is minimized. Current break points for increasing the printed output are set at 10,15,20, and 25. Any value larger than any of these will cause that level of print to be activated.

Dest
This is a temporary location used to store and test the destination level of a MESSAGE. The value is set in event END.XSMN just prior to destruction of the

MESSAGE. Subsequent to the MESSAGE's destruction, DEST is tested to determine which command level must take action on the MESSAGE.

Div.lo.bd
Same as BDE.LO.BD but for the division level.

Div.up.bd
Same as BDE.UP.BD but for the division level.

Dvn
This variable was added to those in use by the STAR model. The number of divisions to be simulated is read into it during initialization of the model.

Flag
This is a temporary storage location used by the print routines. It contains an integer value which uniquely identifies the exit which was taken from the movement decision logic. It is used primarily as an aid to debugging.

Msg
This is the core location of the current MESSAGE. It is a pointer which uniquely identifies the MESSAGE.

Msgno
This is a temporary storage location for the number which is used to distinguish one message between two entities from another. This variable is set by the END.XSMN event just prior to destruction of the MESSAGE.

Orig
This is a temporary storage location for the pointer to the originating UNIT of a MESSAGE. It is set in routine END.XSMN just prior to destruction of the MESSAGE.

Parxx
These are input parameters which are used in the calls to various distributions for the purpose of generating random numbers which are used to schedule events. In general, if xx is between 00 and 49, this should be an integer number.

Text.pointer
This variable is a temporary location used to store the pointer to the TEXT which is associated with a particular MESSAGE. It is set in routine END.XSMN just prior to destruction of the MESSAGE.

Type
This is a temporary location used to store the value of the message type. The value is set in routine END.XSMN just prior to destruction of the MESSAGE, and it is tested in the BN.MSG, BDE.MSG, CO.MSG, and DIV.MSG routines after destruction of the MESSAGE to determine which of the logic routines to call to handle the MESSAGE.

REAL VARIABLES

Chk.time
This is a variable used to store the value returned

from the Fortran function MYTIME in event END.XSMN. The MYTIME routine returns the number of ten thousandths of a second left before the program uses up its allotted CPU time. This number is divided by 10000 and truncated before being stored in CHK.TIME. If the value stored in CHK.TIME is less than 10, a STOP.SIMULATION is scheduled immediately so that the data up to that point will be printed out and not lost as it would be if the job crashed for exceeding its allocated time.

Com.data.dump
This is an input parameter which determines how often the STAT.DUMP routine will be executed to print out the attributes of each CO.COMMANDER, BN.COMMANDER, BDE.COMMANDER, and DIV.COMMANDER. For example, if COM.DATA.DUMP is read in as 600.0 by the user, approximately every 600 seconds of simulation time the attributes will be printed out.

Com.time
This variable is used to store the value of TIME.V each time the routine STAT.DUMP is called. It is used to insure that STAT.DUMP is only called once every COM.DATA.DUMP seconds of simulation time.

Paryy
These are input variables used as parameters for the distributions provided by the Simscript language for scheduling events and generating random numbers. If yy is a value from 50 to 99, the parameter should be a real variable.

Rni
This variable is used in routine SIEZE.NET to select at random the MESSAGE which will get the net from all those stored in MAILBAGs which are assigned to the net.

APPENDIX D

COMMUNICATIONS PERMANENT ENTITIES

BDE.COMMANDER

Bdecur
This attribute is the sum of the weights of all the battalions in the BRIGADE which have requested permission to move from the current coordination line. It is reset to zero each time the brigade first occupies a coordination line.

Bdego
This attribute is a user input upper bound. If BDECUR equals or exceeds this value, all the battalions in the BRIGADE are ordered to move back to their next coordination line position. A distinct BDEGO value is linked to each coordination line which the brigade can occupy.

Bdelo
This attribute is a user input lower bound. If BDECUR equals or exceeds this value, all the battalions in the BRIGADE are given permission to move at will back to their next coordination line position. A distinct BDELO value is linked to each coordination line which the brigade can occupy.

Bdemsn
This user input attribute is stored in the three-dimensional array, BDECORD. It indicates whether or not the brigade has permission to move from a given coordination line. A 1 means that the brigade has permission to move and a 0 means that the brigade does not have permission to move.

Bdereqst
This attribute indicates whether or not a brigade has requested permission to move from its current coordination line poosition. A 1 means that the brigade has requested permission and a 0 means that the brigade has not requested permission to move.

Bdewt
This user input attribute indicates the tactical weight or relative importance of the brigade's position on a particular coordination line. There is a distinct BDEWT value for each of the coordination lines which the brigade can occupy.

Brde
This attribute stores the number designator of the brigade.

No.bde.unit
This attribute stores the number designator of the UNIT/TANK which is associated with the brigade commander.

BN.COMMANDER

Batt
This attribute stores the number designator of the battalion.

Bmsn
This user input attribute indicates whether or not the battalion has permission to withdraw from a particular coordination line. This attribute is stored in the three-dimensional array, BNCORD. A 1 means that the battalion has permission to move while a 0 means that the battalion does not have permission to move.

Bncur
This attribute stores the sum of the weights of the companies which have requested permission to move from their current coordination line position. It is reset to zero each time the battalion first occupies a coordination line.

Bngo
This user input attribute is an upper bound. If BNCUR equals or exceeds this value, all the companies in the BATTALION will be ordered to move back to their next coordination line position. A distinct BNGO value is linked to each coordination line which the battalion can occupy.

Bnlo
This user input attribute is a lower bound. If BNCUR equals or exceeds this value, each company in the BATTALION is given permission to move at will back to its next coordination line position. A distinct BNLO value is linked to each coordination line which the battalion can occupy.

Bnwt
This user input attribute indicates the tactical weight or relative importance of the battalion's position on a given coordination line. There is a distinct BNWT value for each coordination line which the battalion can occupy.

Breqst
This attribute indicates whether or not the battalion has requested permission to move from its current coordination line position. A 1 means that the battalion has requested permission to move while a 0 means that the battalion has not requested permission to move.

No.bn.unit
This attribute stores the number designator of the UNIT/TANK which is associated with the battalion commander.

CO.COMMANDER

Cmsn
This user input attribute stored in the three-dimensional array, COCORD, indicates whether a company has permission to move from a given coordination line position. A 1 means the company has permission to move while a 0 means that the company does not have permission to move.

Compy
This attribute stores the number designator of the UNIT/TANK which is associated with the company commander.

Cowt
This user input attribute indicates the tactical weight or relative importance of the company's position on a given coordination line. There is a distinct COWT value for each coordination line which the company can occupy.

Creqst
This attribute indicates whether the company has requested permission to move from its current coordination line position. A 1 means that the company has requested permission to move while a 0 means that the company has not requested permission to move.

DIV.COMMANDER

Ddiv
This attribute stores the number designator of the division.

Divcur
This attribute stores the sum of the weights of the brigades which have requested permission to move from their current coordination line position. It is reset to zero each time the division first occupies a coordination line.

Divgo
This attribute is a user input upper bound. If DIVCUR equals or exceeds this value, all the brigades in the DIVISION will be ordered to move back to their next coordination line position. A distinct DIVGO value is associated with each coordination line which the division can occupy.

Divlo
This user input attribute is a lower bound. If DIVCUR equals or exceeds this value, each brigade in the DIVISION is given permission to move at will back to its next coordination line position. A distinct DIVLO value is associated with each coordination line which the division can occupy.

Divreqst
This attribute indicates whether the division has requested permission to move from its current coordination line position. A 1 means that it has requested permission to move and a 0 means that it has not requested permission to move.

Divwt
This attribute is a user input which indicates the tactical weight or relative importance of the division's position on a given coordination line. There is a distinct DIVWT for each coordination line which the division can occupy.

No.div.unit
This attribute stores the number designator of the UNIT/TANK which is associated with the division commander.

B.MVR.CDR

Prty
This attribute is used to determine the correct plane of the TABLE array which is to be used for a given UNIT on a given coordination line.

There are many other attributes of the B.MVR.CDRs, but this is the only one which has any importance in the communications model. The rest of the attributes are used for combat analysis of casualties and related statistics.

APPENDIX E

COMMUNICATIONS TEMPORARY ENTITIES

FMNET

Fm.idle
This attribute indicates whether or not the net is in use, with a code of 1, or idle, with a code of 0.

Fmalt.freq
This user input attribute contains the alternate frequency of the FMNET.

Fmpri.freq
This attribute contains the user input primary frequency of the FMNET.

Ncs.point
This attribute contains a pointer to the TANK/UNIT of the net control station for the FMNET.

Num.net
This attribute indicates the numeric designator of this FMNET.

MESSAGE

Addressee
This attribute stores the pointer to the UNIT/TANK which is associated with the commander who is the addressee of the message.

Dest.code
This attribute stores a code value which indicates the level to which the message is being sent. For example, if the value of this variable lies between the user input values for CO.LO.BD and CO.UP.BD, the message will be sent to the company level.

Length.msg
This attribute stores the length of the message in simulated seconds. It is used during event COMMO.ATTEMPT to determine when to schedule the END.XSMN event.

Lst.send.time
This attribute stores the simulated time beyond which the message will not be transmitted. It is used in the DUMP.MAILBAG event to determine if the message should be aborted.

Msg.no
This attribute stores the number of the message in the form nxxx where n is the number of the UNIT/TANK sending the message and xxx is a sequential integer which starts at one and increases one for each message sent by this UNIT/TANK.

Msg.text
This attribute stores the pointer to the text which is created to go with this message.

Msg.type
This attribute indicates the type of the message. For example, a type 30 message is a request for permission to move from the battalion to the brigade.

MYSET

Nxt.msg.no
This attribute stores the number designator of the next message which this particular TANK/UNIT will send.

RT.CONFIG

Ant.type
This attribute contains a code which describes the type of antenna which is used by the radio configuration. If the value is less than zero, the antenna is directional. If the value is greater than zero, the antenna is omnidirectional.

Ant.x.loc
This attribute contains the x coordinate of the location of the antenna which may not be the same as the location of the TANK/UNIT which uses that antenna because remote antennas are allowed.

Ant.y.loc
This attribute contains the y coordinate of the location of the antenna.

In.use
This attribute contains a code which is set to 1 to indicate that the radio set is in use and is set to 0 when the set is not being used.

Mode.operation
This attribute contains a code which designates the mode of operation of the radio.

Own.subscriber
This attribute contains a pointer to the subscriber which owns the TANK/UNIT to which this RT.CONFIG belongs.

Rad.type
This attribute contains a code which designates the type of radio.

Rem.ant
This attribute contains a code which tells if the antenna for this RT.CONFIG is remoted or not. Any value other than zero indicates a remoted antenna.

SUBSCRIBER

Own.net

This attribute contains a pointer to the FMNET which is used.

Own.tank
This attribute contains a pointer to the UNIT/TANK associated with this subscriber.

Tfc.waiting
This attribute contains a code of 1 if there is at least one message filed in this SUBSCRIBER's mailbag waiting to be sent. Otherwise, the value of this attribute is 0.

APPENDIX F

COMMUNICATIONS ARRAYS

BDECORD

The BDECORD array stores five different attributes of the brigades. It is a three dimensional array which has a plane for each blue brigade. Within each plane there is a row for each phase line which the brigade can occupy and within each row there are five columns. One column for each of the five attributes which will be stored. The first column contains BDEMSN, the code for whether or not the brigade has permission to move off this coordination line. The second column contains BDECUR, which is the sum of the weights of the battalions which have requested permission to move from their coordination line positions. The third column contains BDEWT, which is the user supplied estimate of the tactical importance of the brigade on this coordination line. The fourth column contains BDELO, the lower bound which if exceeded by BDECUR causes the brigade to give all its battalions permission to move from their current coordination line positions. The fifth column contains BDEGO, the upper bound which if exceeded by BDECUR causes the brigade to order all its battalions to move from their current coordination line positions. This array is used to reset the attributes of the brigade commanders after they first occupy a coordination line position. The array itself, with the exception of BDEMSN and BDECUR values is loaded during the initialization of the program using input data supplied by the user. A diagram of the way this array is organized is provided in Figure 13.

BNCORD

This array is the same one that is used by the production STAR model. It is explained in Appendix A. A diagram of the organization of the array is provided in Figure 11.

BNETTBL

This two dimensional array is used by the communications routines as a table lookup which contains the subscript number of the UNITS/TANKS which belong to the FMNETs. The subscripts of the TANKS which belong to the ith FMNET are elements of the ith row of the array. Because the FMNETs are not restricted to all having the same number of SUBSCRIBERs, this array is necessarily ragged. An example of this array is provided in Figure 14.

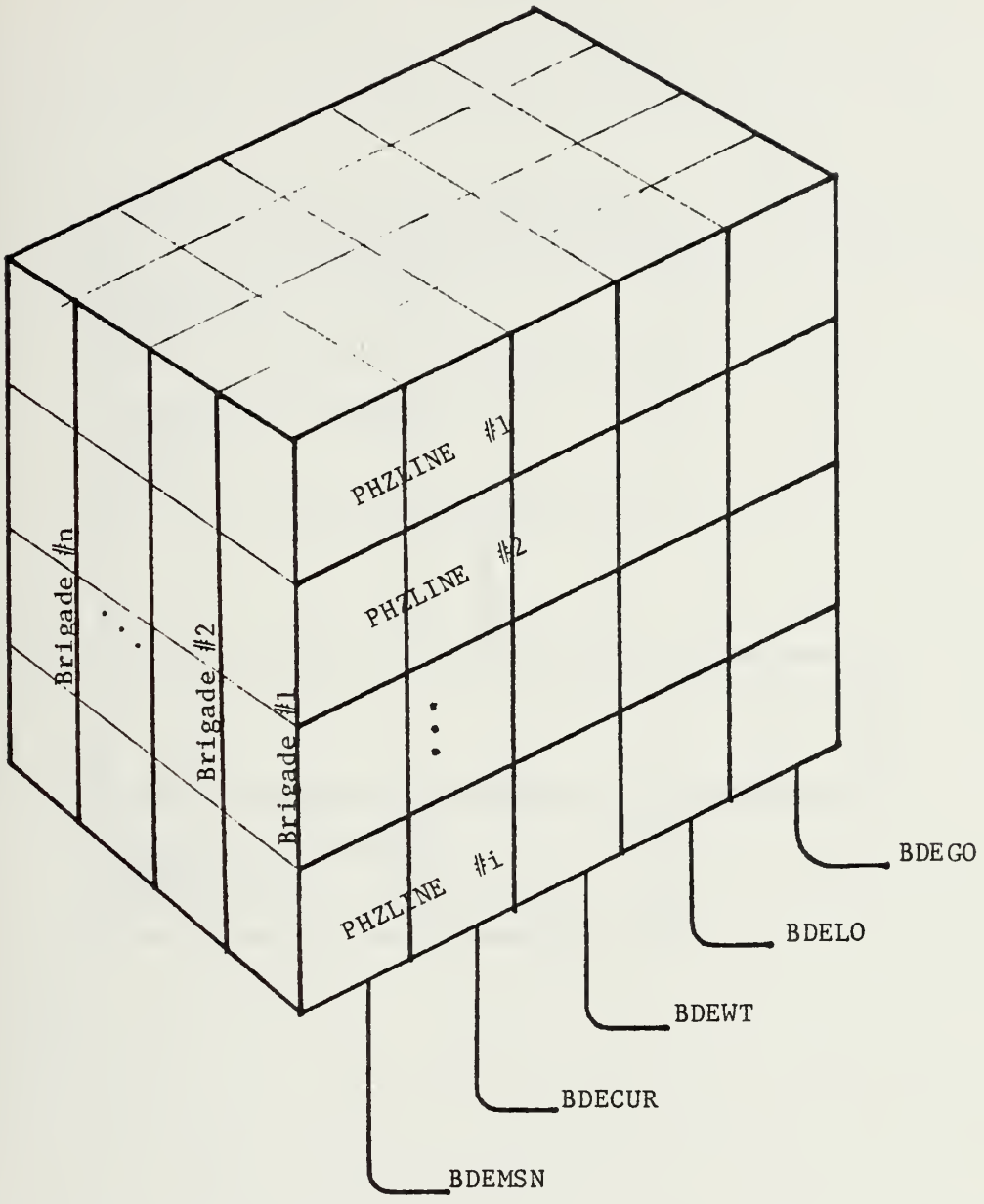
COCORD

This array is the same one that is used by the production STAR model. It is explained in Appendix A. A diagram of the organization of the array is provided in Figure 12.

DIVCORD

This array is similar to the BNCORD AND BDECORD arrays. It contains the same type of data but for the division level as opposed to the brigade level. A diagram of the way this three dimensional array is

BDECORD DIAGRAM



A plane for each brigade

A row in each plane for each phase line

A column in each plane for each of the five attributes

FIGURE 13

BNETTBL DIAGRAM

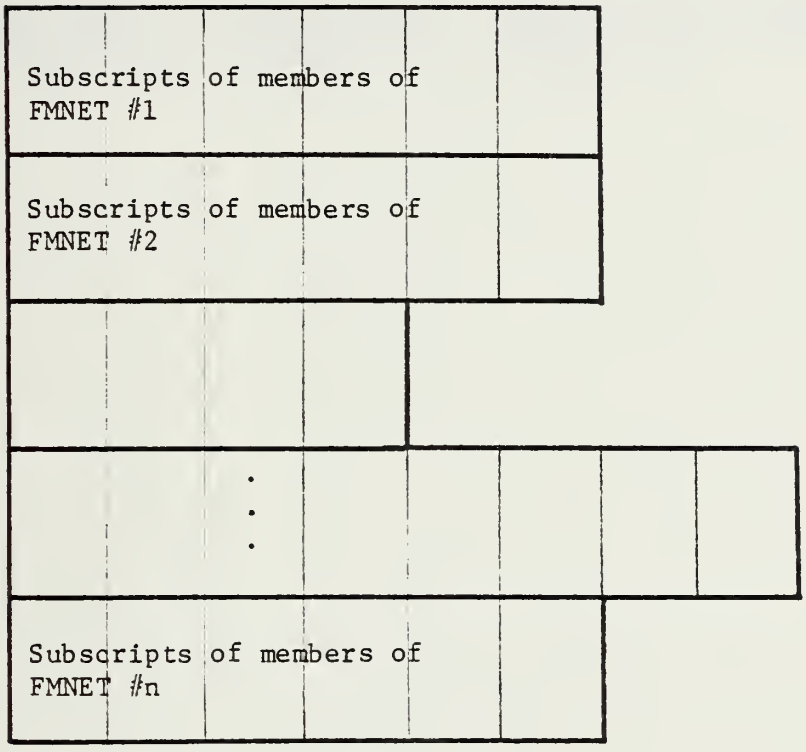


FIGURE 14

organized is provided in Figure 15.

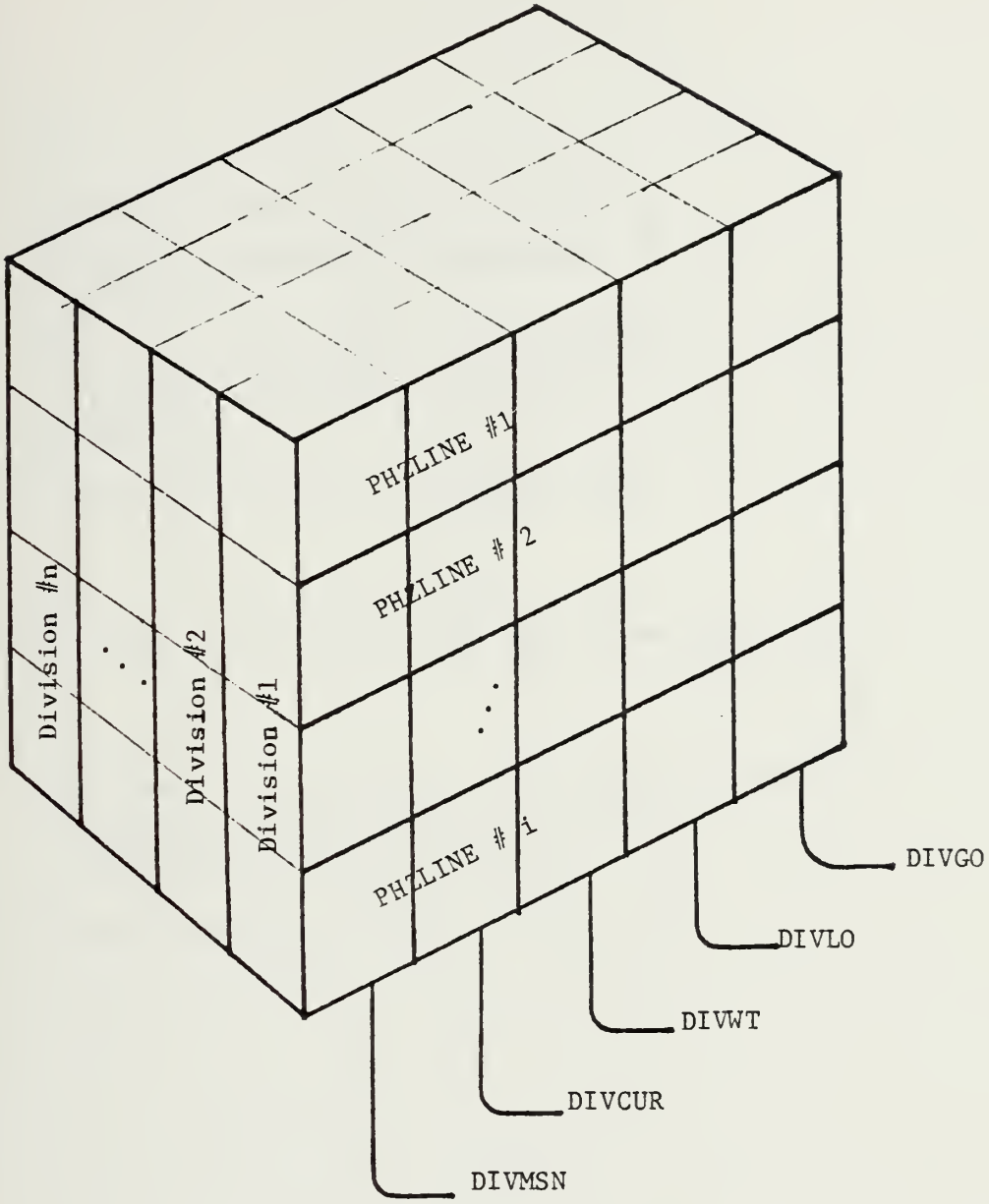
RRPOINT

This two dimensional array is used primarilly as an aid to debugging. It contains the pointer values of the UNITs/TANKs which belong to the ith radio net in the ith row of the array. This array is released after the initialization of the program where it is printed out since the pointers never change during the simulation. A diagram of the organization of this array is provided in Figure 16.

TABLE

This three dimensional array is the same as the one used by the production version of STAR. It is explained in Appendix A. A diagram of the organization of the array is provided in Figure 10.

DIVCORD DIAGRAM



A plane for each division

A row in each plane for each phase line

A column in each plane for each of the five attributes

FIGURE 15

RRPOINT DIAGRAM

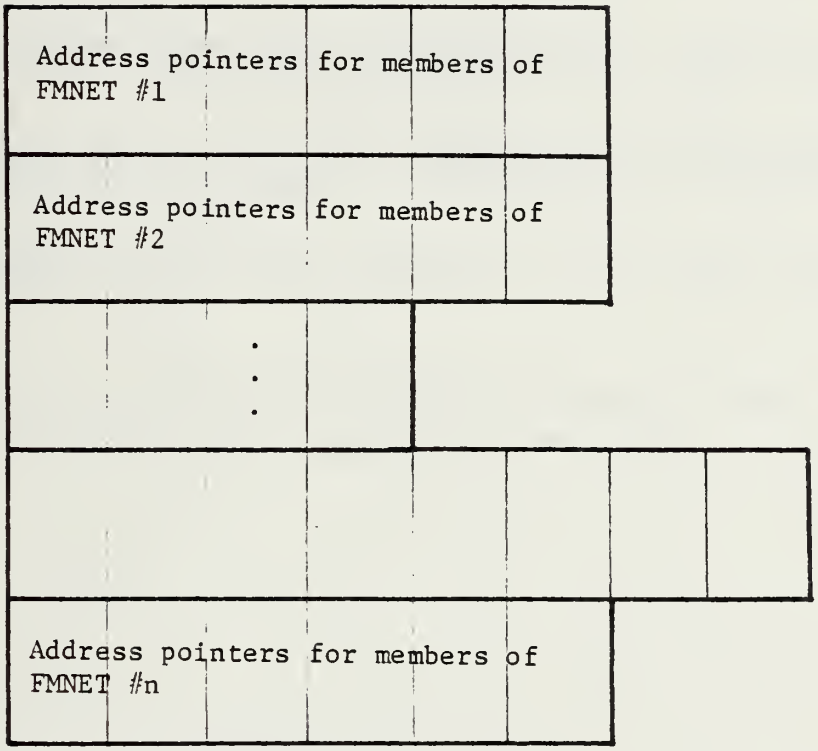


FIGURE 16

APPENDIX G

COMMUNICATIONS SETS

Ceoi.list
This set contains pointers to all the SUBSCRIBERs who have access to a specific FMNET.

Ether
This set contains all the FMNET's which are simulated by the communications model.

Mailbag
This set contains pointers to all the MESSAGEs generated by a given SUBSCRIBER for a given FMNET which haven't been sent.

Rad.list
This set contains pointers to all the RT.CONFIGS of a given TANK.

Figure 2 contains a complete diagram of all the sets and pointers used by the communications model.

APPENDIX H

```
1       ROUTINE DECISION(ROW,COL,T)
2
3                 ''THIS ROUTINE EXAMINES THE STATUS OF THE SECTION OR COMPANY TO WHICH
4                     ''TANK T BELONGS AND DETERMINES WHETHER OR NOT MOVEMENT IS ALLOWED
5
6       IF COM.PRINT GT 20 PRINT 1 LINE WITH TIME.V THUS
7            INTO DECISION AT ******.***
8       ALWAYS
9       LET ORDER= NO
10      IF MVARY(ROW,COL) GE 4 LET ORDER=YES
11           IF COM.PRINT GT 15
12           .    PRINT 1 LINE WITH ROW AND COL AS FOLLOWS
13      33333-----STATUS OF MVARY(ROW=******,COL=******) CAUSED EXIT WITH ORDER=YES
14                SKIP 1 LINE
15           ALWAYS
16           GO TO ACT4, ACT5, ACT6 PER (MVARY(ROW,COL) - 3)
17           'ACT4'
18                CALL BN.GO(T,SYS,WPN)
19                GO TO ACT.NOW
20           'ACT5'
21                CALL OTHER.GO(T,SYS,WPN)
22                GO TO ACT.NOW
23           'ACT6'
24                CALL MOUNTER(T,SYS,WPN)
25           'ACT.NOW'
26                SCHEDULE A RE.MV.STATE(CO(T)) IN 60 UNITS
27           RETURN
28      ELSE
29      IF TABLE(PRTY(CO(T)),ROW,4)=0
30
31                ''THE SECTION OR COMPANY IS NOT RESTRICTED FROM MOVING AT WILL.
32
33           LET ORDER=YES LET FLAG=1
34           CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
35           LET ORIG=RRRPOINT(CO(T))
36           LET ADDR.STORE = RRRPOINT(NO.BN.UNIT(BN(T)))
37           CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
38
39                ''GENERATE A MESSAGE INFORMING THE BATTALION OF THE CO/SEC MOVE.
40
41           LET DEST.CODE(MSG) = BN.LEVEL
42           IF ROW EQ 7 LET MSG.TYPE(MSG) = CO.TELLS.BN.OF.CO.MOVE
43                     CALL CO.GO(T,SYS,WPN)
44                     SCHEDULE A RE.MV.STATE(CO(T)) IN 60 UNITS
45                IF RANGE(CHK.RNG) LE TABLE(PRTY(CO(T)),ROW,3)
46                     PRINT 1 LINE AS FOLLOWS
47           +++ DECISION BASED ON RANGE TO ENEMY ++++++
48                ALWAYS
49           ELSE
50                LET MSG.TYPE(MSG) = CO.NOTIF.BN.OF.SEC.MOVE
```

```
51              IF RANGE(CHK.RNG) LE TABLE(PRTY(CO(T)),ROW,3)
52                   PRINT 1 LINE AS FOLLOWS
53         +++ DECISION BASED ON RANGE TO ENEMY ++++++
54                   CALL VEH.GO(T,TABLE(PRTY(CO(T)),I,1),TABLE(PRTY(CO(T)),I,2))
55                   CALL CHG.STATUS(T)
56                   RETURN
57              ELSE
58         LET SYS=TABLE(PRTY(CO(T)),ROW,1)
59         LET WPN=TABLE(PRTY(CO(T)),ROW,2)
60         CALL CHG.STATUS(T)
61         GO TO ACT1, ACT2 PER MVARY(ROW,COL)
62         'ACT1'
63              CALL SEC.GO(T,SYS,WPN)
64              GO TO ACT.LATER
65         'ACT2'
66              CALL PLT.GO(T,SYS,WPN)
67         'ACT.LATER'
68              SCHEDULE A RE.MV.STATE(CO(T)) IN 60 UNITS
69         ALWAYS
70         SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) NOW
71         RETURN
72    ELSE
73    IF CREQST(CO(T)) EQ 1
74
75              **THIS COMPANY HAS PREVIOUSLY REQUESTED PERMISSION TO MOVE.
76
77         IF COM.PRINT GT 15
78              PRINT 1 LINE AS FOLLOWS
79    11111-----CREQST(CO(T)) EQ 1 CAUSED A RETURN
80         ALWAYS
81         RETURN
82    ELSE
83    LET ACHK=TRUNC.F(AREA.START(T)/100)
84    IF ACHK GT PHAROW
85
86              **DETERMINE IF THE COMPANY IS ON THE SAME PHASE LINE AS THE REST OF
87                   **ITS SISTER UNITS.  IF IT IS FARTHER TO THE REAR, DO NOT ALLOW A
88                   **REQUEST TO MOVE.
89
90         IF COM.PRINT GT 15
91              PRINT 1 LINE WITH ACHK AND PHAROW AS FOLLOWS
92    22222-----STATUS OF ACHK=xxx  GT PHAROW=xxx CAUSED A RETURN
93         ALWAYS
94         RETURN
95    ELSE
96    IF COCORD(CO(T),ACHK,1)=1
97
98              **THE COMPANY IS RESTRICTED BUT HAS BEEN GIVEN PERMISSION TO MOVE.
99
100        LET ORDER=YES LET FLAG=2
```

```
101         CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
102         LET ORIG=RRRPOINT(CO(T))
103         LET ADDR.STORE = RRRPOINT(NO.BN.UNIT(BN(T)))
104         CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
105
106              ''GENERATE A MESSAGE INFORMING THE BATTALION OF THE CO/SEC MOVE.
107
108         LET DEST.CODE(MSG) = BN.LEVEL
109         IF ROW EQ 7 LET MSG.TYPE(MSG) = CO.TELLS.BN.OF.CO.MOVE
110                   CALL CO.GO(T,SYS,WPN)
111                   SCHEDULE A RE.MV.STATE(CO(T)) IN 60 UNITS
112              IF RANGE(CHK.RNG) LE TABLE(PRTY(CO(T)),ROW,3)
113                   PRINT 1 LINE AS FOLLOWS
114         +++ DECISION BASED ON RANGE TO ENEMY ++++++
115              ALWAYS
116         ELSE
117              LET MSG.TYPE(MSG) = CO.NOTIF.BN.OF.SEC.MOVE
118              IF RANGE(CHK.RNG) LE TABLE(PRTY(CO(T)),ROW,3)
119                   PRINT 1 LINE AS FOLLOWS
120         +++ DECISION BASED ON RANGE TO ENEMY ++++++
121                   CALL VEH.GO(T,TABLE(PRTY(CO(T)),I,1),TABLE(PRTY(CO(T)),I,2))
122                   CALL CHG.STATUS(T)
123                   RETURN
124              ELSE
125         LET SYS=TABLE(PRTY(CO(T)),ROW,1)
126         LET WPN=TABLE(PRTY(CO(T)),ROW,2)
127         CALL CHG.STATUS(T)
128         GO TO BCT1, BCT2 PER MVARY(ROW,COL)
129         'BCT1'
130              CALL SEC.GO(T,SYS,WPN)
131              GO TO BCT.LATER
132         'BCT2'
133              CALL PLT.GO(T,SYS,WPN)
134         'BCT.LATER'
135              SCHEDULE A RE.MV.STATE(CO(T)) IN 60 UNITS
136         ALWAYS
137         SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) NOW
138         RETURN
139    ELSE
140    LET FLAG=3
141    LET ORIG=RRRPOINT(CO(T))
142    LET ADDR.STORE = RRRPOINT(NO.BN.UNIT(BN(T)))
143    CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
144
145              ''GENERATE A MESSAGE TO THE BATTALION REQUESTING PERMISSION TO MOVE.
146
147    LET DEST.CODE(MSG) = BN.LEVEL
148    LET MSG.TYPE(MSG) = CO.BN.REQ.PERM.TO.MOVE
149    SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) NOW
150    RETURN
```

```
151     END
152
153
```

APPENDIX I

```
1       ROUTINE DEC.CO
2       DEFINE J AS AN INTEGER VARIABLE
3
4       IF COM.PRINT GT 20 PRINT 1 LINE WITH TIME.V THUS
5            ENTERED DEC.CO ROUTINE AT TIME.V=xxxxx.xxx
6       ALWAYS
7       LET TEXT(x) = TEXT.POINTER
8       LET PHAROW = TEXT(1)
9       LET ORDER = TEXT(2)
10      LET T = TEXT(3)
11      LET CRIT = TEXT(4)
12      LET P.Z.TIME = TEXT(5)
13      LET TEXT(x)=0
14      IF CO.CAN.NOT.MOVE
15           LET COCORD(CO(T),PHAROW,1) = 0
16           IF COM.PRINT GT 15
17                PRINT 1 LINE WITH CO(T) THUS
18           COMPANY xx HAS BEEN ORDERED NOT TO MOVE
19           ALWAYS
20           SKIP 2 LINES
21           RETURN
22      ELSE
23      IF CO.MAY.MOVE
24           IF COM.PRINT GT 15
25                PRINT 1 LINE WITH CO(T) THUS
26           COMPANY xx HAS BEEN GIVEN PERMISSION TO MOVE AT WILL
27                SKIP 2 LINES
28           ALWAYS
29           LET COCORD(CO(T),PHAROW,1) = 1
30      ALWAYS
31      IF CO.ORDERED.TO.MOVE
32           IF COM.PRINT GT 15
33                PRINT 1 LINE WITH CO(T) THUS
34           COMPANY xx HAS BEEN ORDERED TO MOVE
35                SKIP 2 LINES
36           ALWAYS
37           LET COCORD(CO(T),PHAROW,1) = 1
38           FOR EACH TANK IN BLUE.ALIVE WITH CO(TANK)= COMPY(COMPANY.COMMANDER)
39                UNTIL J=1, DO
40                CALL AIR.COMMO(TANK,3)  LET CRIT=4
41                CALL CO.GO(TANK,0,0)
42                SCHEDULE A RE.MV.STATE(CO(TANK)) IN 60 UNITS
43                LET J=J+1
44           LOOP
45           LET ORDER=2
46           LET FLAG = 4
47           CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
48           LET FLAG = 0
49           RETURN
50      ELSE
```

```
51      LET ACHK = TRUNC.F(AREA.START(T)/100)
52      IF COCORD(CO(T),ACHK,1)=1
53           LET ORDER=YES
54      ALWAYS
55      LET FLAG = 15
56      CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
57      LET FLAG = 0
58      RETURN
59      END
60
61
```

APPENDIX J

```
1       ROUTINE DEC.BN
2
3       IF COM.PRINT GT 20 PRINT 1 LINE WITH TIME.V THUS
4            ENTERED DEC.BN ROUTINE AT TIME.V=xxxxx.xxx
5       ALWAYS
6       LET TEXT(x) = TEXT.POINTER
7       LET PHAROW = TEXT(1)
8       LET ORDER = TEXT(2)
9       LET T = TEXT(3)
10      LET CRIT = TEXT(4)
11      LET P.Z.TIME = TEXT(5)
12      LET TEXT(x)=0
13      IF CREQST(CO(T)) EQ 0 AND TYPE EQ CO.BN.REQ.PERM.TO.MOVE
14           LET CRIT=1 LET BNCUR(BN(T))=BNCUR(BN(T)) + COWT(CO(T))
15           LET CREQST(CO(T))=1
16      ALWAYS
17      IF CO.HAS.MOVED
18           IF COM.PRINT GT 15
19                PRINT 1 DOUBLE LINE WITH ORIG, ADRSEE, AND TEXT.POINTER AS FOLLOWS
20      44444+++++CO xxxxxxxx NOTIFIED BN xxxxxxxx BY MESSAGE (TEXT=xxxxxxxx) THAT IT IS
21       MOVING FROM ITS CURRENT POSITION.
22           ALWAYS
23           LET BNCUR(BN(T)) = BNCUR(BN(T)) + COWT(CO(T))
24           LET FLAG=16
25           LET T=RRRPOINT(NO.BN.UNIT(BN(T)))
26           LET ADDR.STORE =   RRRPOINT(NO.BDE.UNIT(BDE(T)))
27           CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
28           LET DEST.CODE(MSG) = BDE.LEVEL
29           LET MSG.TYPE(MSG) = BN.NOTIF.BDE.OF.CO.MOVE
30           LET ORIG = T
31           SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO6.DISTR(PAR60,PAR61,4) UNITS
32           RETURN
33      ELSE
34      IF SEC.HAS.MOVED
35           IF COM.PRINT GT 15
36                PRINT 1 DOUBLE LINE WITH ORIG, ADRSEE, AND TEXT.POINTER THUS
37      66666+++++CO xxxxxxxx NOTIFIED BN xxxxxxxx BY MESSAGE (TEXT=xxxxxxxx) THAT ONE O
38      F ITS SECTIONS IS MOVING FROM ITS POSITION.
39           ALWAYS
40           RETURN
41      ELSE
42      IF BN.ORDERED.TO.MOVE
43           LET BNCORD(BATT(BN(T)),PHAROW,1) = 1
44           LET BNCUR(BN(T))=BNCUR(BN(T))+ BNGO(BN(T))
45      ELSE
46           IF BN.MAY.MOVE
47                LET BNCORD(BATT(BN(T)),PHAROW,1) = 1
48                LET BNCUR(BN(T)) = BNLO(BN(T))
49           ELSE
50                IF BN.CAN.NOT.MOVE
```

```
51                    LET BNCORD(BATT(BN(T)),PHAROW,1) = 0
52                    RETURN
53               ELSE
54          ALWAYS
55     ALWAYS
56     LET TEMP=ADRSEE LET ADRSEE=ORIG LET ORIG=TEMP
57     IF BNCORD(BATT(BN(T)),PHAROW,1) =1
58
59               **THIS BATTALION HAS PERMISSION TO MOVE AT WILL.
60
61          IF BNCUR(BN(T)) GE BNGO(BN(T)) .
62
63               **THE CRITICAL STATUS OF THE BATTALION HAS EXCEEDED ITS GO THRESHHOLD.
64
65               IF COM.PRINT GT 15
66                    PRINT 1 LINE WITH BN(T), TIME.V AS FOLLOWS
67          BN(xx) NOT RESTRICTED AND ORDERED COMPANIES TO MOVE AT xxxxx.xxx
68               ALWAYS
69               FOR EACH COMPANY.COMMANDER IN BATTALION(BN(T)), DO
70                    LET FLAG=9
71                    LET T=RRRPOINT(COMPY(COMPANY.COMMANDER))
72                    LET ADDR.STORE = T
73                    CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME)
74                         YIELDING MSG
75                    LET DEST.CODE(MSG) = CO.LEVEL
76                    LET MSG.TYPE(MSG)=CO.TOLD.TO.MOVE.BY.BN
77                    SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN
78                         COMO5.DISTR(PAR58,PAR59,5) UNITS
79               LOOP
80               LET FLAG=15
81               LET T=RRRPOINT(NO.BN.UNIT(BN(T)))
82               LET ADDR.STORE = RRRPOINT(NO.BDE.UNIT(BDE(T)))
83               CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
84
85               **GENERATE A MESSAGE INFORMING BDE THAT ALL COS ARE BEING ORDERED TO
86                    **MOVE AS SOON AS POSSIBLE.
87
88               LET DEST.CODE(MSG) = BDE.LEVEL
89               LET MSG.TYPE(MSG) = BN.TELLS.BDE.OF.BN.MOVE
90               IF COM.PRINT GT 15
91                    PRINT 1 DOUBLE LINE WITH ORIG, ADDR.STORE, AND MSG.NO(MSG) THUS
92     77777+++++BN xxxxxxxx NOTIFIED BDE xxxxxxxx BY MESSAGE NO xxxxxx THAT IT HAS ORD
93     ERED ALL COMPANIES TO MOVE AS SOON AS POSSIBLE.
94               ALWAYS
95               SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO6.DISTR(PAR60,PAR61,4) UNITS
96               RETURN
97          ELSE
98          IF BNCUR(BN(T)) GE BNLO(BN(T))
99
100              **THE BATTALION CRITICAL STATUS HAS EXCEEDED THE LO THRESHHOLD.
```

```
101
102             IF COM.PRINT GT 15
103                  PRINT 1 LINE WITH BN(T), TIME.V AS FOLLOWS
104        BN(**) NOT RESTRICTED AND GAVE COS PERMISSION TO MOVE AT ******.***
105             ALWAYS
106             FOR EACH COMPANY.COMMANDER IN BATTALION(BN(T)), DO
107                  LET FLAG=10
108                  LET T=ARRPOINT(COMPY(COMPANY.COMMANDER))
109                  LET ADDR.STORE = T
110                  CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME)
111                       YIELDING MSG
112                  LET DEST.CODE(MSG) = CO.LEVEL
113                  LET MSG.TYPE(MSG) = BN.GAVE.CO.PERM.TO.MOVE
114                  SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN
115                       COMO5.DISTR(PAR58,PAR59,5) UNITS
116             LOOP
117             LET FLAG=11
118             LET T=ARRPOINT(NO.BN.UNIT(BN(T)))
119             LET ADDR.STORE = ARRPOINT(NO.BDE.UNIT(BDE(T)))
120             CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
121
122             **GENERATE A MESSAGE INFORMING BDE THAT ALL COS HAVE BEEN GIVEN
123                  **PERMISSION TO MOVE AT WILL.
124
125             LET DEST.CODE(MSG) = BDE.LEVEL
126             LET MSG.TYPE(MSG)= BN.TELLS.BDE.OF.BN.MOVE
127             IF COM.PRINT GT 15
128                  PRINT 1 DOUBLE LINE WITH ORIG, ADDR.STORE, AND MSG.NO(MSG) THUS
129    88888+++++BN ******** NOTIFIED BDE ******** BY MESSAGE NO ****** THAT IT HAS GIV
130    EN ALL COMPANIES PERMISSION TO MOVE AT WILL.
131             ALWAYS
132             SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO6.DISTR(PAR60,PAR61,4) UNITS
133             RETURN
134        ELSE
135        IF COM.PRINT GT 15
136             PRINT 1 LINE WITH BN(T), TIME.V AS FOLLOWS
137        BN(**) NOT RESTRICTED AND ORDERED COMPANY NOT TO MOVE AT ******.***
138        ALWAYS
139        LET FLAG = 12
140        LET ADDR.STORE = ADRSEE
141        LET T = ADRSEE
142        CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
143        LET DEST.CODE(MSG) = CO.LEVEL
144        LET MSG.TYPE(MSG)=BN.DIR.CO.NOT.TO.MOVE
145        SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO5.DISTR(PAR58,PAR59,5) UNITS
146        RETURN
147    ELSE
148    IF BNCUR(BN(T)) GE BNLO(BN(T))
149        IF COM.PRINT GT 15
150             PRINT 1 LINE WITH BN(T) AND TIME.V THUS
```

```
151          BN(**) IS RESTRICTED AND IS REQUESTING PERMISSION TO MOVE AT ******.***
152          ALWAYS
153          LET FLAG = 13
154          LET T=RRRPOINT(NO.BN.UNIT(BN(T)))
155          LET ADDR.STORE =    RRRPOINT(NO.BDE.UNIT(BDE(T)))
156          CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
157          LET DEST.CODE(MSG) = BDE.LEVEL
158          LET MSG.TYPE(MSG)=BN.BDE.REQ.PERM.TO.MOVE
159          SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO6.DISTR(PAR60,PAR61,4) UNITS
160          RETURN
161     ELSE
162          IF COM.PRINT GT 15
163               PRINT 1 LINE WITH BN(T) AND TIME.V THUS
164          BN(**) IS RESTRICTED AND ORDERED THE REQUESTING CO NOT TO MOVE AT ******.***
165          ALWAYS
166     LET FLAG=14
167     CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
168     LET ADDR.STORE = ADRSEE
169     LET T = ADRSEE
170     CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
171     LET DEST.CODE(MSG) = CO.LEVEL
172     LET MSG.TYPE(MSG)=BN.DIR.CO.NOT.TO.MOVE
173     SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO5.DISTR(PAR58,PAR59,5) UNITS
174     RETURN
175     END
176
177
```

APPENDIX K

```
1       ROUTINE DEC.BDE
2
3       IF COM.PRINT GT 20 PRINT 1 LINE WITH TIME.V THUS
4            ENTERED DEC.BDE ROUTINE AT TIME.V=xxxxx.xxx
5       ALWAYS
6       LET TEXT(x) = TEXT.POINTER
7       LET PHAROW = TEXT(1)
8       LET ORDER = TEXT(2)
9       LET T = TEXT(3)
10      LET CRIT = TEXT(4)
11      LET P.Z.TIME = TEXT(5)
12      LET TEXT(x)=0
13      IF BREQST(BN(T))=0 AND TYPE EQ BN.BDE.REQ.PERM.TO.MOVE
14           LET CRIT=2
15           LET BDECUR(BDE(T))=BDECUR(BDE(T))+BNWT(BN(T))
16           LET BREQST(BN(T))=1
17      ALWAYS
18      IF BN.HAS.MOVED
19           IF COM.PRINT GT 15
20                PRINT 1 DOUBLE LINE WITH ORIG, ADDRESSEE(MSG), AND TEXT.POINTER THUS
21      55555+++++BN xxxxxxxx NOTIFIED BRIGADE xxxxxxxx BY MESSAGE xxxxxxxx THAT IT HAS
22      MOVED FROM ITS POSITION
23           ALWAYS
24           LET BDECUR(BDE(T)) = BDECUR(BDE(T)) + BNWT(BN(T))
25           LET FLAG=21
26           LET T=RRRPOINT(NO.BDE.UNIT(BDE(T)))
27           LET ADDR.STORE =   RRRPOINT(NO.DIV.UNIT(DIV(T)))
28           CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
29           LET DEST.CODE(MSG) = DIV.LEVEL
30           LET MSG.TYPE(MSG) = BDE.NOTIF.DIV.OF.BN.MOVE
31           LET ORIG = T
32           SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO3.DISTR(PAR54,PAR55,9) UNITS
33           RETURN
34      ELSE
35      IF CO.HAS.MOVED
36           IF COM.PRINT GT 15
37                PRINT 1 DOUBLE LINE WITH ORIG, ADRSEE, AND TEXT.POINTER AS FOLLOWS
38      AAAAA+++++BN xxxxxxxx NOTIFIED BDE xxxxxxxx BY MESSAGE (TEXT=xxxxxxxxx) THAT ONE
39      OF ITS COMPANIES IS MOVING FROM ITS POSITION.
40           ALWAYS
41           RETURN
42      ELSE
43      IF BDE.ORDERED.TO.MOVE
44           LET BDECORD(BRDE(BDE(T)),PHAROW,1) = 1
45           LET BDECUR(BDE(T)) = BDECUR(BDE(T)) + BDEGO(BDE(T))
46      ELSE
47           IF BDE.MAY.MOVE
48                LET BDECORD(BRDE(BDE(T)),PHAROW,1) = 1
49                LET BDECUR(BDE(T)) = BDELO(BDE(T))
50           ELSE
```

```
51              IF BDE.CAN.NOT.MOVE
52                   LET BDECORD(BRDE(BDE(T)),PHAROW,1) = 0
53                   RETURN
54              ELSE
55         ALWAYS
56     ALWAYS
57     LET TEMP=ADRSEE LET ADRSEE=ORIG LET ORIG=TEMP
58     IF BDECORD(BRDE(BDE(T)),PHAROW,1) = 1
59
60              **THIS BRIGADE HAS PERMISSION TO MOVE AT WILL.
61
62     IF BDECUR(BDE(T)) GE BDEGO(BDE(T))
63
64              **THE CRITICAL STATUS OF THE BRIGADE HAS EXCEEDED ITS GO THRESHHOLD.
65
66          LET CRIT = 4
67          IF COM.PRINT GT 15
68               PRINT 1 LINE WITH BDE(T) AND TIME.V THUS
69          BDE(**) NOT RESTRICTED AND ORDERED BATTALIONS TO MOVE AT ******.***
70          ALWAYS
71          FOR EACH BN.COMMANDER IN BRIGADE(BDE(T)),DO
72               LET FLAG=5
73               LET T=ARRPOINT(NO.BN.UNIT(BN.COMMANDER))
74               LET  ADDR.STORE = T
75               CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
76               LET DEST.CODE(MSG) = BN.LEVEL
77               LET MSG.TYPE(MSG)=BN.TOLD.TO.MOVE.BY.BDE
78               SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COM04.DISTR(PAR56,PAR57,7) UNITS
79          LOOP
80               LET FLAG = 17
81               LET T = ARRPOINT(NO.BDE.UNIT(BDE(T)))
82               LET ADDR.STORE = ARRPOINT(NO.DIV.UNIT(BDE(T)))
83               CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
84
85               **GENERATE A MESSAGE INFORMING DIV THAT ALL BNS ARE BEING ORDERED TO
86                    **MOVE AS SOON AS POSSIBLE.
87
88               LET DEST.CODE(MSG) = DIV.LEVEL
89               LET MSG.TYPE(MSG) = BDE.LETS.DIV.KNOW.OF.BDE.MOVE
90               IF COM.PRINT GT 15
91                    PRINT 1 DOUBLE LINE WITH ORIG, ADDR.STORE, AND MSG.NO(MSG) THUS
92     BBBBB+++++BDE ******** NOTIFIED DIV ******** BY MESSAGE NO ****** THAT IT HAS OR
93     DERED ALL BATTALIONS TO MOVE AS SOON AS POSSIBLE.
94               ALWAYS
95               SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COM03.DISTR(PAR54,PAR55,9) UNITS
96          RETURN
97     ELSE
98     IF BDECUR(BDE(T)) GE BDELO(BDE(T))
99
100              **THE BRIGADE CRITICAL STATUS HAS EXCEEDED THE LO THRESHHOLD.
```

```
101
102         LET CRIT=3
103         IF COM.PRINT GT 15
104              PRINT 1 LINE WITH BDE(T) AND TIME.V THUS
105         BDE(**) NOT RESTRICTED AND GAVE BNS PERMISSION TO MOVE AT *****.***
106         ALWAYS
107         FOR EACH BN.COMMANDER IN BRIGADE(BDE(T)), DO
108              LET FLAG=6
109              LET T=RRRPOINT(NO.BN.UNIT(BN.COMMANDER))
110              LET ADDR.STORE = T
111              CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
112              LET DEST.CODE(MSG) = BN.LEVEL
113              LET MSG.TYPE(MSG)=BDE.GAVE.BN.PERM.TO.MOVE
114              SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO4.DISTR(PAR56,PAR57,7) UNITS
115         LOOP
116              LET FLAG = 18
117              LET T = RRRPOINT(NO.BDE.UNIT(BDE(T)))
118              LET ADDR.STORE = RRRPOINT(NO.DIV.UNIT(BDE(T)))
119              CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
120
121              **GENERATE A MESSAGE INFORMING DIV THAT ALL BNS HAVE BEEN GIVEN
122                   **PERMISSION TO MOVE AT WILL.
123
124              LET DEST.CODE(MSG) = DIV.LEVEL
125              LET MSG.TYPE(MSG) = BDE.LETS.DIV.KNOW.OF.BDE.MOVE
126              IF COM.PRINT GT 15
127                   PRINT 1 OOUBLE LINE WITH ORIG, ADDR.STORE, AND MSG.NO(MSG) THUS
128    CCCCC+++++BDE ******** NOTIFIED DIV ******** BY MESSAGE NO ****** THAT IT HAS GI
129    VEN ALL BATTALIONS PERMISSION TO MOVE AT WILL.
130              ALWAYS
131              SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO3.DISTR(PAR54,PAR55,9) UNITS
132         RETURN
133    ELSE
134         IF COM.PRINT GT 15
135              PRINT 1 LINE WITH BDE(T) AND TIME.V AS FOLLOWS
136         BDE(**) NOT RESTRICTED AND ORDERED THE BATTALION NOT TO MOVE AT *****.***
137         ALWAYS
138         LET FLAG=7
139         LET ADDR.STORE = ADRSEE
140         LET T = ADRSEE
141         CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
142         LET DEST.CODE(MSG) = BN.LEVEL
143         LET MSG.TYPE(MSG)=BDE.DIR.BN.NOT.TO.MOVE
144              SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COMO4.DISTR(PAR56,PAR57,7) UNITS
145         RETURN
146    ELSE
147    IF BDECUR(BDE(T)) GE BDELO(BDE(T))
148         IF COM.PRINT GT 15
149              PRINT 1 LINE WITH BDE(T) AND TIME.V THUS
150         BDE(**) IS RESTRICTED AND IS REQUESTING PERMISSION TO MOVE AT *****.*****
```

```
151          ALWAYS
152          LET FLAG = 19
153          LET T=RRRPOINT(NO.BDE.UNIT(BDE(T)))
154          LET ADDR.STORE = RRRPOINT(NO.DIV.UNIT(DIV(T)))
155          CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
156          LET DEST.CODE(MSG) = DIV.LEVEL
157          LET MSG.TYPE(MSG) = BDE.DIV.REQ.PERM.TO.MOVE
158          SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COM03.DISTR(PAR54,PAR55,9) UNITS
159          RETURN
160     ELSE
161          IF COM.PRINT GT 15
162               PRINT 1 LINE WITH BDE(T) AND TIME.V THUS
163          BDE(**) IS RESTRICTED AND ORDERED THE REQUESTING BN NOT TO MOVE AT *****.**
164          ALWAYS
165     LET FLAG = 20
166     CALL EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
167     LET ADDR.STORE = ADRSEE
168     LET T = ADRSEE
169     CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
170     LET DEST.CODE(MSG) = BN.LEVEL
171     LET MSG.TYPE(MSG) = BDE.DIR.BN.NOT.TO.MOVE
172     SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COM04.DISTR(PAR56,PAR57,7) UNITS
173     RETURN
174     END
175
176
```

APPENDIX L

```
1       ROUTINE DEC.DIV
2
3       IF COM.PRINT GT 20
4            PRINT 1 LINE WITH TIME.V THUS
5            ENTERED DEC.DIV ROUTINE AT TIME.V = ******.***
6       ALWAYS
7       LET TEXT(*) = TEXT.POINTER
8       LET PHAROW = TEXT(1)
9       LET ORDER = TEXT(2)
10      LET T = TEXT(3)
11      LET CRIT = TEXT(4)
12      LET P.Z.TIME = TEXT(5)
13      LET TEXT(*)=0
14      IF BDEREQST(BDE(T))=0 AND TYPE EQ BDE.DIV.REQ.PERM.TO.MOVE
15           LET CRIT=5
16           LET DIVCUR(DIV(T))=DIVCUR(DIV(T)) + BDEWT(BDE(T))
17           LET DIVREQST(BDE(T))=1
18      ALWAYS
19           IF COM.PRINT GT 15
20                PRINT 1 LINE WITH DIV(T) AND TIME.V THUS
21           DIV(**) NOT RESTRICTED AND GAVE BDES PERMISSION TO MOVE AT ******.***
22           ALWAYS
23           FOR EACH BDE.COMMANDER IN DIVISION(DIV(T)), DO
24                LET FLAG=22
25                LET T=RRRPOINT(NO.BDE.UNIT(BDE.COMMANDER))
26                LET ADDR.STORE = T
27                CALL GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
28                LET DEST.CODE(MSG) = BDE.LEVEL
29                LET MSG.TYPE(MSG)=DIV.GAVE.BDE.PERM.TO.MOVE
30                SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) IN COM20.DISTR(PAR71,PAR72,7) UNITS
31           LOOP
32      RETURN
33      END
34
35
```

APPENDIX M

```
1       ROUTINE EXIT(ORDER,T,CRIT,P.Z.TIME,FLAG)
2
3       IF CRIT NE 0 AND CRIT LE 3
4            LET CRIT = CRIT - 1
5            CALL AIR.COMMO(T,CRIT)
6            LET CRIT = CRIT + 1
7       ALWAYS
8       IF (ORDER=0  OR  ORDER=2) AND P.Z.TIME=NO
9            SCHEDULE A PHAZ.CHK IN 60 UNITS LET P.Z.TIME=YES
10      ALWAYS
11      IF ORDER=2 LET ORDER=NO
12      ALWAYS
13      IF COM.PRINT GT 20 PRINT 1 LINE WITH TIME.V AND FLAG THUS
14           OUT OF DECISION AT ******.*** THROUGH EXIT **
15      ALWAYS
16      RETURN
17      END
18
19
```

APPENDIX N

```
1       ROUTINE GEN.MOVE.DECISION.MSG(PHAROW,ORDER,T,CRIT,P.Z.TIME) YIELDING MSG
2
3       CREATE A MESSAGE CALLED MSG
4       RESERVE TEXT(*) AS 5
5       LET MSG.TEXT(MSG)=TEXT(*)
6       LET TEXT(1)=PHAROW
7       LET TEXT(2)=ORDER
8       LET TEXT(3)=T
9       LET TEXT(4)=CRIT
10      LET TEXT(5)=P.Z.TIME
11      LET ADDRESSEE(MSG)=ADDR.STORE
12      LET LENGTH.MSG(MSG)=30.0
13      LET LST.SEND.TIME(MSG)=TIME.V + 1200.0
14      LET MSG.NO(MSG) = NXT.MSG.NO(FMTANK.LIST(ORIG))
15      ADD 1 TO NXT.MSG.NO(FMTANK.LIST(ORIG))
16      IF COM.PRINT GT 15
17           SKIP 1 LINE
18           PRINT 1 LINE WITH TIME.V AS FOLLOWS
19      *****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V=******.***
20           PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), ORIG, ADDRESSEE(MSG), TEXT(*),
21                PHAROW, ORDER, T, CRIT, AND FLAG THUS
22           MSG.NO ******   FROM *********  TO *********  TEXT *********  PHAROW **  ORDER
23       **  T *********  CRIT ***              RETURN **
24      ALWAYS
25      LET TEXT(*) =0
26      LET FLAG = 0
27      RETURN
28      END
29
30
```

APPENDIX O

```
1
2
3       ROUTINE COM.MAIN
4       RESERVE DUMMY(*) AS 1
5       CALL BUILDNETS
6       CALL CHECKNETS
7       CALL BNETTBL
8       CALL COMMGEAR
9       CALL COMMCHECK
10      CALL INITIALIZE
11      LET FMNET = F.ETHER
12      SCHEDULE A DUMP.MAILBAG IN 600.0 UNITS
13      SCHEDULE A MSG.GEN(FMNET) IN COM01.DISTR(PAR50,PAR51,1) UNITS
14      IF COM.PRINT GT 25
15           START NEW PAGE
16           LIST ATTRIBUTES OF EACH B.MVR.COR
17           IF LINE.V GT 20
18                START NEW PAGE
19           ALWAYS
20           LIST ATTRIBUTES OF EACH UNIT IN BLUE.ALIVE
21      ALWAYS
22      START NEW PAGE
23      RETURN
24      END
```

APPENDIX P

```
1       ROUTINE BUILDNETS
2       DEFINE I, J, K, NALTFR, NETNO, NFMN, NONETS, NORELAY, NPRI, NRSUB, NTCK, TKALT,
3            AND TKHOLD AS INTEGER VARIABLES
4
5         READ  NONETS, NORELAY
6         IF NONETS IS EQUAL TO ZERO,
7             GO TO X3
8         OTHERWISE
9           FOR I = 1 TO NONETS, DO
10            LET NETNO = 0  ''DONE TO AID ERROR IDENTIFICATION''
11            READ NFMN, NRSUB, NALTFR
12            READ NTCK AND NPRI
13            IF NTCK IS NOT EQUAL TO NFMN,
14              GO TO ERROR
15            OTHERWISE
16            CREATE AN FMNET
17            FILE FMNET IN THE ETHER
18              FOR J=1 TO NRSUB, DO
19                READ  TKHOLD
20                CREATE A SUBSCRIBER
21                LET TFC.WAITING(SUBSCRIBER) = 0
22                LET OWN.NET(SUBSCRIBER) = FMNET
23                LET OWN.TANK(SUBSCRIBER) = ARRPOINT(TKHOLD)
24                FILE SUBSCRIBER IN CEOI.LIST(FMNET)
25              LOOP
26            LET NUM.NET(FMNET) = NFMN
27            LET FM.IDLE(FMNET) = IDLE
28            LET FMPRI.FREQ(FMNET) = NPRI
29            IF NALTFR IS EQUAL TO ZERO,
30              LET FMALT.FREQ(FMNET) = 0
31              GO TO X4
32            OTHERWISE
33              READ NETNO
34              IF NETNO IS NOT EQUAL TO NFMN,
35                GO TO ERROR
36              OTHERWISE
37              RESERVE FM.PUSHES(*) AS (NALTFR + 1)
38              LET FMALT.FREQ(FMNET) = FM.PUSHES(*)
39              LET FM.PUSHES(1) = NALTFR
40              FOR K=1 TO NALTFR, DO
41                READ TKALT
42                LET FM.PUSHES(K+1) = TKALT
43              LOOP
44      'X4'  ''CONTINUE''
45            LET FM.PUSHES(*) = 0
46          LOOP
47      'X3'  ''CONTINUE''
48          RETURN
49
50      'ERROR'  ''CONTINUE''
```

```
51              PRINT 2 LINES WITH NFMN, NTCK AND NETNO LIKE THIS
52          ERROR, NET NUMBER ××××, SUBS. NUMBER ××××,
53          AND ALT.FREQ NET NUMBER ××××  ARE INCONSISTENT
54             SKIP 1 LINE
55             PRINT 1 LINE WITH NONETS AND NORELAY LIKE THIS
56          NONETS=××××, NOREALY=××××
57             PRINT 1 LINE WITH NFMN, NRSUB, NALTFR LIKE THIS
58          NFMN=××××, NRSUB=××××, NALTFR=××××
59             PRINT 1 LINE WITH NTCK,NPRI,TKHOLD LIKE THIS
60          NTCK=××××, NPRI=××××,TKHOLD= ××××
61              STOP
62      END
63
64
```

APPENDIX Q

```
1       ROUTINE CHECKNETS
2       DEFINE I AND NFMALT AS INTEGER VARIABLES
3
4         FOR EACH FMNET IN THE ETHER, DO
5           IF LINE.V GT 57 START NEW PAGE
6           ALWAYS
7           PRINT 1 LINE WITH NUM.NET(FMNET) LIKE THIS
8            FOR NET NUMBER ××××
9           SKIP 1 LINE
10          PRINT 1 LINE WITH FMPRI.FREQ(FMNET) LIKE THIS
11           PRIMARY FREQUENCY IS  ×××××××××× KHZ
12
13          IF FMALT.FREQ(FMNET) IS NOT EQUAL TO ZERO,
14            LET FM.PUSHES(×) = FMALT.FREQ(FMNET)
15            LET NFMALT = FM.PUSHES(1)
16            PRINT 1 LINE WITH NFMALT LIKE THIS
17           THERE ARE ×××××××× ALTERNATE FREQUENCIES
18            FOR I = 1 TO NFMALT, DO
19              PRINT 1 LINE WITH FM.PUSHES(I+1) LIKE THIS
20           ××××××××××
21            LOOP
22          OTHERWISE
23            PRINT 1 LINE LIKE THIS
24           THERE ARE NO ALTERNATE FREQUENCIES
25          ALWAYS
26          PRINT 1 LINE WITH N.CEOI.LIST(FMNET) LIKE THIS
27           THERE ARE ××××× SUBSCRIBERS IN THE NET,
28              SKIP 3 LINES
29          LOOP
30          RETURN
31          END
32
33
```

APPENDIX R

```
1       ROUTINE BNETTBL
2       DEFINE I AND J AS INTEGER VARIABLES
3
4         RESERVE NETTBL(*,*) AS N.ETHER BY *
5         RESERVE RPOINT(*,*) AS N.ETHER BY *
6         LET I = 1
7         FOR EVERY FMNET IN THE ETHER, DO
8           RESERVE NETTBL(I,*) AS N.CEOI.LIST(FMNET)
9           RESERVE RPOINT(I,*) AS N.CEOI.LIST(FMNET)
10          LET J = 1
11          FOR EVERY SUBSCRIBER IN CEOI.LIST(FMNET), DO
12            LET NETTBL(I,J) = TK.ID(OWN.TANK(SUBSCRIBER))
13            LET RPOINT(I,J) = SUBSCRIBER
14            LET J = J + 1
15          LOOP
16          LET I = I + 1
17        LOOP
18
19        IF LINE.V GT 62 START NEW PAGE
20        ALWAYS
21        PRINT 1 LINE LIKE THIS
22           THE ITH ROW OF ARRAY NETTBL CONTAINS THE SUBSCRIBERS IN THE ITH RADIO NET
23        LIST NETTBL
24        SKIP 2 LINES
25        IF LINE.V GT 68 START NEW PAGE
26      . ALWAYS
27        PRINT 1 DOUBLE LINE LIKE THIS
28           THE ITH ROW OF THE ARRAY RPOINT CONTAINS THE ADDRESS POINTERS OF THE SUBSCR
29      IBERS IN THE ITH RADIO NET
30        LIST RPOINT
31        SKIP 2 LINES
32        RELEASE RPOINT(*,*)
33        RETURN
34      END
35
36
```

APPENDIX S

```
1       ROUTINE COMMGEAR
2       DEFINE I, J, NORAD, NRADIO.TANKS, AND TKNO AS INTEGER VARIABLES
3
4         READ NRADIO.TANKS
5
6         FOR I = 1 TO NRADIO.TANKS, DO
7           READ TKNO, NORAD
8           CREATE A MYSET
9           LET  TANK = RRRPOINT(TKNO)
10          LET  FMTANK.LIST(TANK) = MYSET
11          FOR J = 1 TO NORAD, DO
12            CREATE AN RT.CONFIG
13            FILE RT.CONFIG IN RAD.LIST(MYSET)
14            READ RAD.TYPE(RT.CONFIG) AND MODE.OPERATION(RT.CONFIG)
15            READ ANT.TYPE(RT.CONFIG)
16            IF ANT.TYPE(RT.CONFIG) IS LESS THAN ZERO,
17                ''DIRECTIONAL ANTENNA INPUT''
18              PRINT 3 LINES WITH TKNO, NORAD, J, RAD.TYPE(RT.CONFIG),
19                MODE.OPERATION(RT.CONFIG) AND ANT.TYPE(RT.CONFIG) LIKE THIS
20           ON TANK ****, WITH A TOTAL OF **** RADIOS, FOR RADIO SET
21           NUMBER ****, OF TYPE ****, MODE ****, AND ANTENNA ****
22           -----THIS SET OPERATES A DIRECTIONAL ANTENNA
23              STOP
24            ALWAYS
25            READ REM.ANT(RT.CONFIG)
26            IF  REM.ANT(RT.CONFIG) IS NOT EQUAL TO ZERO,
27                ''REMOTED ANTENNA INPUT''
28              PRINT 3 LINES WITH TKNO, NORAD, J, RAD.TYPE(RT.CONFIG),
29                MODE.OPERATION(RT.CONFIG) AND ANT.TYPE(RT.CONFIG) LIKE THIS
30           ON TANK ****, WITH A TOTAL OF **** RADIOS, FOR RADIO SET
31           NUMBER ****, OF TYPE **** AND MODE ****, WITH ANTENNA ****
32           -----THIS SET OPERATES WITH A REMOTED ANTENNA
33              STOP
34            REGARDLESS
35          LOOP
36        LOOP
37
38            ''USE NET STRUCTURE INPUT PREVIOUSLY TO ASSIGN EQUIPMENTS''
39               ''TO NETS''
40
41          IF LINE.V GT 30 START NEW PAGE
42          ALWAYS
43          PRINT 4 LINES AS FOLLOWS
44           RRRPOINT(TK.ID(TANK)) = TANK
45           FMTANK.LIST(TANK) = MYSET(TANK)
46
47
48        FOR EVERY FMNET IN THE ETHER, DO
49          PRINT 1 LINE WITH NUM.NET(FMNET) AND FMNET AS FOLLOWS
50           NUM.NET(FMNET) = ***      FMNET POINTER = *********
```

```
51          SKIP 1 LINE
52          FOR EVERY SUBSCRIBER IN CEOI.LIST(FMNET), DO
53            LET TANK = OWN.TANK(SUBSCRIBER)
54            IF FMTANK.LIST(TANK) EQUALS ZERO,
55              GO TO ERROR1
56            OTHERWISE
57            LET MYSET = FMTANK.LIST(TANK)
58            LET NXT.MSG.NO(MYSET) = (TK.ID(OWN.TANK(SUBSCRIBER)) * 1000) + 1
59            FOR EVERY RT.CONFIG IN RAD.LIST(MYSET), DO
60              IF OWN.SUBSCRIBER(RT.CONFIG) EQUALS ZERO,
61                GO TO JOIN.NET
62              OTHERWISE
63            LOOP
64            GO TO ERROR2
65
66      'JOIN.NET'  ''PLACE THIS EQUIPMENT ON THE NET''
67            LET OWN.SUBSCRIBER(RT.CONFIG) = SUBSCRIBER
68            PRINT 1 DOUBLE LINE WITH TK.ID(TANK), TANK, FMTANK.LIST(TANK), RT.CONFIG,
69                  AND OWN.SUBSCRIBER(RT.CONFIG) AS FOLLOWS
70           TK.ID(TANK)=*****         TANK=*********         FMTANK.LIST(TANK)=*********
71           RT.CONFIG=*********         SUBSCRIBER=*********
72
73          LOOP
74          SKIP 1 LINE
75        LOOP
76          SKIP 5 LINES
77
78      RETURN
79
80      'ERROR1'  ''ERROR WHEN TANK HAS NO RADIOS''
81        PRINT 1 LINE WITH TK.ID(TANK) AND NUM.NET(FMNET) LIKE THIS
82           ERROR, TANK **** ON NET **** HAS NO RADIOS
83        STOP
84
85      'ERROR2'  ''ERROR WHEN TANK HAS TOO FEW RADIOS FOR ASGD. NETS''
86        PRINT 1 LINE WITH TK.ID(TANK) AND NUM.NET(FMNET) LIKE THIS
87           ERROR, TANK **** HAS TOO FEW RADIOS TO BE ON NET ****
88        STOP
89
90      END
91
92
```

APPENDIX T

```
1       ROUTINE COMMCHECK
2
3       FOR EACH TANK IN BLUE.ALIVE, DO
4         IF LINE.V GT 60 START NEW PAGE
5         ALWAYS
6         IF FMTANK.LIST(TANK) IS EQUAL TO ZERO,
7           PRINT 2 LINES WITH TK.ID(TANK), X.CURRENT(TANK),
8             Y.CURRENT(TANK) AND Z.CURRENT(TANK) LIKE THIS
9            TANK ****
10           LOCATED AT ****.*, ****.*, ****.* HAS_NO COMMO EQUIPMENT
11          GO TO X1
12
13        OTHERWISE
14        PRINT 2 LINES WITH TK.ID(TANK), X.CURRENT(TANK),
15          Y.CURRENT(TANK) AND Z.CURRENT(TANK) LIKE THIS
16           TANK ****
17           LOCATED AT ****.*, ****.*, ****.* HAS THE FOLLOWING COMMO
18        SKIP 1 LINE
19
20        LET MYSET = FMTANK.LIST(TANK)
21        FOR EACH RT.CONFIG IN RAD.LIST(MYSET), DO
22          PRINT 2 LINES WITH RAD.TYPE(RT.CONFIG) AND
23            MODE.OPERATION(RT.CONFIG) LIKE THIS
24           RADIO TYPE = ***
25           -----MODE OF OPERATION = ****
26          IF ANT.TYPE(RT.CONFIG) IS LESS THAN ZERO
27            PRINT 1 LINE LIKE THIS
28           -----THIS SET OPERATES A DIRECTIONAL ANTENNA
29            STOP
30          OTHERWISE
31            PRINT 1 LINE WITH ANT.TYPE(RT.CONFIG) LIKE THIS
32           ANTENNA TYPE = ****
33          IF REM.ANT(RT.CONFIG) IS NOT EQUAL TO ZERO
34            PRINT 1 LINE LIKE THIS
35           -----THIS SET OPERATES A REMOTED ANTENNA
36              ''GO TO NO.NET''
37            STOP
38          OTHERWISE
39            PRINT 1 LINE WITH X.CURRENT(TANK), Y.CURRENT(TANK),
40              AND Z.CURRENT(TANK) LIKE THIS
41           ANTENNA LOCATION: X = *****.*, Y = *****.*, Z = *****.*
42
43      'NO.NET'   ''CONTINUE''
44          PRINT 1 LINE WITH NUM.NET(OWN.NET(OWN.SUBSCRIBER(RT.CONFIG)))
45            LIKE THIS
46           -----THIS SET IS TUNED TO NET NUMBER ****
47          SKIP 1 LINE
48        LOOP
49
50      'X1'  ''CONTINUE''
```

```
51        SKIP 5 LINES
52
53      LOOP
54      RETURN
55      END
56
57
```

```
1
2
3       ROUTINE INITIALIZE
4       DEFINE I, J, K, AND NPRI AS INTEGER VARIABLES
5
6       READ PAR00, PAR01, PAR02, PAR03, PAR04, PAR05, PAR06, PAR07, PAR08, AND PAR09
7       READ PAR10 AND PAR11
8       READ PAR50, PAR51, PAR52, PAR53, PAR54, PAR55, PAR56, PAR57, PAR58, AND PAR59
9       READ PAR60, PAR61, PAR62, PAR63, PAR64, PAR65, PAR66, PAR67, PAR68, AND PAR69
10      READ PAR70, PAR71, AND PAR72
11      START NEW PAGE
12      IF COM.PRINT GT 10
13           CALL STAT.DUMP
14           CALL SSTAT.DUMP
15      ALWAYS
16      READ C0.L0.B0 AND C0.UP.B0
17      READ BN.L0.B0 AND BN.UP.B0
18      READ BDE.L0.B0 AND BDE.UP.B0
19      READ DIV.L0.B0 AND DIV.UP.B0
20      RETURN
21      END
```

```
1
2
3       ROUTINE STAT.DUMP
4
5       LIST ATTRIBUTES OF EACH COMPANY.COMMANDER
6       LIST ATTRIBUTES OF EACH BN.COMMANDER
7       LIST ATTRIBUTES OF EACH BDE.COMMANDER
8       LIST ATTRIBUTES OF EACH DIV.COMMANDER
9       SKIP 2 LINES
10      RETURN
11      END
```

```
1
2
3       ROUTINE SSTAT.DUMP
4       DEFINE I AND J AS INTEGER VARIABLES
5
6            FOR I = 1 TO BBDE, DO
7                 IF LINE.V GT 70 START NEW PAGE
8                 ALWAYS
9                 PRINT 1 LINE WITH I AS FOLLOWS
10           BRIGADE **
11                PRINT 3 LINES AS FOLLOWS
12                          BDEMSN      BDECUR    BDEWT     BDELO     BDEGO
13      ------------------------------------------------------------------------
14           PHZLINES    .
15                     FOR J=1 TO PHZLINES, DO
16                          PRINT 1 LINE WITH J, BDECORD(I,J,1), BDECORD(I,J,2),
17                              BDECORD(I,J,3), BDECORD(I,J,4), AND BDECORD(I,J,5) THUS
18                     ** .  *****     *****     *****     *****     *****
19                     LOOP
20           SKIP 2 LINES
21           LOOP
22           FOR I=1 TO BBN, DO
23                IF LINE.V GT 70 START NEW PAGE
24                ALWAYS
25                PRINT 1 LINE WITH I AS FOLLOWS
26           BATTALION **
27                PRINT 3 LINES AS FOLLOWS
28                          BMSN      BNCUR     BNWT      BNLO      BNGO
29      ------------------------------------------------------------------------
30           PHZLINES    .
31                     FOR J=1 TO PHZLINES, DO
32                          PRINT 1 LINE WITH J, BNCORD(I,J,1), BNCORD(I,J,2),
33                              BNCORD(I,J,3), BNCORD(I,J,4), AND BNCORD(I,J,5) THUS
34                     ** .  *****     *****     *****     *****     *****
35                     LOOP
36           SKIP 2 LINES
37           LOOP
38           FOR I=1 TO BLCOMP, DO
39                IF LINE.V GT 70 START NEW PAGE
40                ALWAYS
41                PRINT 1 LINE WITH I AS FOLLOWS
42           COMPANY **
43                PRINT 3 LINES AS FOLLOWS
44                          CMSN      COWT
45      ------------------------------------------------------------------------
46           PHZLINES    .
47                     FOR J=1 TO PHZLINES, DO
48                          PRINT 1 LINE WITH J, COCORD(I,J,1), AND COCORD(I,J,2) THUS
49                     ** .  *****     *****
50                     LOOP
```

```
51          SKIP 2 LINES
52          LOOP
53      RETURN
54      END
```

APPENDIX X

```
1       UPON COMMO.ATTEMPT(ORIG,MSG)
2
3         IF COM.PRINT GT 20
4            PRINT 1 LINE WITH TIME.V THUS
5            ENTERED COMMO.ATTEMPT EVENT AT TIME.V=******.***
6         ALWAYS
7         LET CALLNET = 0
8         LET CALLSUB = 0
9         LET CALLRT = 0
10        LET ADRSEE = ADDRESSEE(MSG)
11        LET OR.TANK = TK.ID(ORIG)
12        LET DE.TANK = TK.ID(ADRSEE)
13
14      ''CHECK THAT BOTH TANKS HAVE RADIOS''
15        IF FMTANK.LIST(ORIG) IS EQUAL TO ZERO,
16          GO TO ERR1
17        OTHERWISE
18        IF FMTANK.LIST(ADRSEE) IS EQUAL TO ZERO,
19          GO TO ERR1
20        OTHERWISE
21
22      ''CHECK THAT DESTINATION AND ORIGINATOR ARE ON SAME NET''
23        LET MYSET = FMTANK.LIST(ORIG)
24        FOR EVERY RT.CONFIG IN RAD.LIST(MYSET), DO
25          LET FMNET = OWN.NET(OWN.SUBSCRIBER(RT.CONFIG))
26          FOR EVERY SUBSCRIBER IN CEOI.LIST(FMNET), DO
27            IF OWN.TANK(SUBSCRIBER) = ADRSEE,
28              LET CALLRT = RT.CONFIG
29              LET CALLSUB = SUBSCRIBER
30              LET CALLNET = FMNET
31              IF FM.IDLE(FMNET) IS EQUAL TO IDLE,
32                GO TO TRY.CALL
33              OTHERWISE
34            REGARDLESS
35          LOOP
36        LOOP
37        IF CALLRT IS NOT EQUAL TO ZERO,
38          GO TO NET.BUSY
39        OTHERWISE
40          GO TO ERR2
41
42      ''TRY TO CALL THE DISTANT STATION''
43      'TRY.CALL'
44        IF COM.PRINT GT 25
45           PRINT 1 LINE WITH MSG, CALLNET, ORIG, AND ADRSEE AS FOLLOWS
46           -----MSG=*********  FMNET=*********  ORIGINATOR=*********  ADDRESSEE=*********
47        ALWAYS
48        LET FM.IDLE(CALLNET) = BUSY
49        LET IN.USE(CALLRT) = BUSY
50        LET NET.NO = NUM.NET(CALLNET)
```

```
51        LET MYSET = FMTANK.LIST(ADRSEE)
52        FOR EVERY RT.CONFIG IN RAD.LIST(MYSET), DO
53          IF OWN.NET(OWN.SUBSCRIBER(RT.CONFIG)) = CALLNET,
54            GO TO KEY.MIKE
55          OTHERWISE
56        LOOP
57        GO TO NO.ANS
58
59
60      ''CHECK IF COMMO IS TECHNICALLY FEASIBLE''
61      'KEY.MIKE'
62        LET RECRT = RT.CONFIG
63        IF COM.PRINT GT 25
64          PRINT 1 LINE WITH CALLRT AND RECRT AS FOLLOWS
65           -----TRANSMITTER/CALLRT=××××××××          RECEIVER/RECRT=××××××××
66        ALWAYS
67        CALL TECH.COMMO(CALLRT,RECRT) YIELDING ABILITY
68
69        IF ABILITY = ROGER,
70          LET IN.USE(RECRT) = BUSY
71          LET DELT = LENGTH.MSG(MSG)
72         CALL EW.ROUTINE(CALLRT,RECRT) YIELDING ABILITY
73        IF ABILITY = JAMMED
74           IF COM.PRINT GT 20
75                PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
76                     TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
77           MSG.NO ××××××  OF TYPE ×××  ON NET ×××  FROM TANK ×××  TO TANK ×××
78              +++   JAMMED   +++
79                SKIP 1 LINE
80                ALWAYS
81          SCHEDULE A CHANGE.FREQ(CALLRT,CALLNET,MSG) IN COM15.DISTR(PAR69,PAR70,2)
82                UNITS
83          RETURN
84        OTHERWISE
85           IF COM.PRINT GT 20
86                PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
87                     TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
88           MSG.NO ××××××  OF TYPE ×××  ON NET ×××  FROM TANK ×××  TO TANK ×××
89              +++   NORMAL TRANSMISSION   +++
90           ALWAYS
91          SCHEDULE AN END.XSMN(CALLRT,RECRT,CALLNET,MSG) IN DELT UNITS
92          RETURN
93        OTHERWISE
94
95        IF ABILITY = NEGATIVE
96      ''DISTANT STATION DOES NOT RESPOND TO CALL''
97      'NO.ANS'
98           IF COM.PRINT GT 20
99                PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
100                    TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
```

```
101         MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
102           +++   NO RESPONSE TO CALL   +++
103             SKIP 1 LINE
104             ALWAYS
105       LET TFC.WAITING(CALLSUB) = WAITING
106       SCHEDULE A NO.CONTACT(CALLRT,CALLNET,MSG) IN COM14.DISTR(PAR67,PAR68,2) UNITS
107       RETURN
108       OTHERWISE
109
110       IF ABILITY = MARGINAL
111         LET IN.USE(RECRT) = BUSY
112         LET DELT = 2*LENGTH.MSG(MSG)
113        CALL EW.ROUTINE(CALLRT,RECRT) YIELDING ABILITY
114       IF ABILITY = JAMMED
115          IF COM.PRINT GT 20
116               PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
117                    TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
118          MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
119             +++   JAMMED   +++
120               SKIP 1 LINE
121               ALWAYS
122         SCHEDULE A CHANGE.FREQ(CALLRT,CALLNET,MSG) IN COM15.DISTR(PAR69,PAR70,2)
123               UNITS
124         RETURN
125       OTHERWISE
126          IF COM.PRINT GT 20
127               PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
128                    TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
129          MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
130             +++   MARGINAL TRANSMISSION   +++
131               ALWAYS
132         SCHEDULE AN END.XSMN(CALLRT,RECRT,CALLNET,MSG) IN DELT UNITS
133         RETURN
134       OTHERWISE
135         GO TO ERR3
136
137     'NET.BUSY'
138     ''FILE MESSAGE AND CONTINUE WHEN NET IS BUSY''
139          IF COM.PRINT GT 20
140       PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
141               TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
142          MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
143             +++   NET BUSY, MSG FILED IN MAILBAG   +++
144       SKIP 1 LINE
145       ALWAYS
146       FILE THIS MSG IN MAILBAG(MYSET)
147       LET TFC.WAITING(CALLSUB) = WAITING
148       RETURN
149
150     ''ERROR ROUTINES ''
```

```
151
152     'ERR1'
153       PRINT 2 LINES WITH TIME.V, OR.TANK AND DE.TANK LIKE THIS
154          AT *****.**, TANK **** TRIED TO SEND A MESSAGE TO TANK ****
155          ONE OF THESE DOES NOT HAVE A RADIO
156       STOP
157
158     'ERR2'
159       PRINT 2 LINES WITH TIME.V, OR.TANK, AND DE.TANK LIKE THIS
160          AT *****.**, TANK **** TRIED TO SEND A MESSAGE TO TANK ****
161          THESE TANKS ARE NOT ON A COMMON NET
162         STOP
163
164     'ERR3'
165       PRINT 2 LINES WITH TIME.V, OR.TANK, AND DE.TANK LIKE THIS
166          AT *****.**, TANK **** TRIED TO CONTACT TANK **** ON THE FM
167          AN ERRONEOUS ABILITY VALUE WAS RETURNED BY TECH.COMMO
168       STOP
169     END
170
171
```

APPENDIX Y

```
1       ROUTINE TECH.COMMO(CALLRT,RECRT) YIELDING ABILITY
2
3       IF COM.PRINT GT 25
4            PRINT 1 DOUBLE LINE WITH TK.ID(OWN.TANK(OWN.SUBSCRIBER(CALLRT))), CALLRT,
5                 TK.ID(OWN.TANK(OWN.SUBSCRIBER(RECRT))), AND RECRT AS FOLLOWS
6            -----MSG FROM TANK ××× TRANSMITTER=×××××××××  TO TANK ××× RECEIVER=×××××××××
7               +++   TECH.COMMO   +++
8       ALWAYS
9       LET ABILITY = COM13.DISTR(PAR04,PAR03,2)
10      RETURN
11      END
12
13
14      ROUTINE EW.ROUTINE(CALLRT,RECRT) YIELDING ABILITY
15
16      IF COM.PRINT GT 20
17           PRINT 1 LINE WITH TIME.V AS FOLLOWS
18           +++++  ENTERED EW ROUTINE AT TIME = ××××××.×××××  +++++
19           SKIP 1 LINE
20      ALWAYS
21      LET ABILITY = COM13.DISTR(PAR04,PAR05,2)
22      RETURN
23      END
24
25
```

APPENDIX Z

```
1       UPON CHANGE.FREQ(CALLRT,CALLNET,MSG)
2
3         LET FM.IDLE(CALLNET) = IDLE
4         LET IN.USE(CALLRT) = IDLE
5         LET ORIG = OWN.TANK(OWN.SUBSCRIBER(CALLRT))
6         IF COM.PRINT GT 20
7              PRINT 1 DOUBLE LINE WITH TIME.V, TK.ID(ORIG) AND
8                     NUM.NET(CALLNET) LIKE THIS
9            TIME.V  *****.**     TANK ***,                              ON NET ***
10              +++   FREQUENCY CHANGE   +++
11           SKIP 1 LINE
12        ALWAYS
13
14        SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) NOW
15
16      RETURN
17      END
18
19
```

APPENDIX AA

```
1
2
3       ROUTINE EW.ROUTINE(CALLAT,RECAT) YIELDING ABILITY
4       DEFINE ABILITY, CALLAT, AND RECAT AS INTEGER VARIABLES
5
6       IF COM.PRINT GT 20
7            PRINT 1 LINE WITH TIME.V AS FOLLOWS
8            +++++  ENTERED EW ROUTINE AT TIME = ******.******  +++++
9            SKIP 1 LINE
10      ALWAYS
11      LET ABILITY = COM13.DISTR(PAR04,PAR05,2)
12      RETURN
13      END
```

APPENDIX BB

```
1       UPON NO.CONTACT(CALLRT,CALLNET,MSG)
2
3       IF COM.PRINT GT 25
4            PRINT 1 LINE WITH TIME.V THUS
5            NO CONTACT EVENT ENTERED AT TIME.V=******.***
6            SKIP 1 LINE
7       ALWAYS
8         LET FM.IDLE(CALLNET) = IDLE
9         LET IN.USE(CALLRT) = IDLE
10
11        CALL SIEZE.NET(CALLNET)
12        LET MYSET = FMTANK.LIST(OWN.TANK(OWN.SUBSCRIBER(CALLRT)))
13        FILE THIS MSG IN MAILBAG(MYSET)
14
15      RETURN
16      END
17
18
```

APPENDIX CC

```
1       ROUTINE SIEZE.NET(CALLNET)
2       DEFINE I, IK, AND SUBREC AS INTEGER VARIABLES
3
4       IF COM.PRINT GT 20
5            PRINT 1 LINE WITH TIME.V AS FOLLOWS
6            ENTERED SIEZE.NET ROUTINE AT TIME.V=******.***
7       ALWAYS
8       RESERVE TARRAY(*) AS 2*N.CEOI.LIST(CALLNET)
9       LET I=1
10      FOR EVERY SUBSCRIBER IN CEOI.LIST(CALLNET), DO
11           LET MYSET = FMTANK.LIST(OWN.TANK(SUBSCRIBER))
12           IF N.MAILBAG(MYSET) = 0, GO TO LOOP
13           OTHERWISE
14           FOR EVERY MESSAGE IN MAILBAG(MYSET), DO
15                LET ADRSEE = ADDRESSEE(MESSAGE)
16                FOR EVERY SUBREC IN CEOI.LIST(CALLNET), DO
17                     IF OWN.TANK(SUBREC) = ADRSEE, GO TO MATCH
18                     OTHERWISE
19                LOOP
20           LOOP
21      GO TO LOOP
22
23      'MATCH'
24
25      LET TARRAY(I) = OWN.TANK(SUBSCRIBER)
26      LET TARRAY(I+1) = MESSAGE
27      LET I = I+2
28
29      'LOOP'
30
31      LOOP
32
33      IF I = 1
34           IF COM.PRINT GT 20
35                PRINT 1 DOUBLE LINE WITH TIME.V AND NUM.NET(CALLNET) AS FOLLOWS
36           TIME.V  ******.***                                        NET ***
37              +++   EMPTY MAILBAG   +++
38                SKIP 1 LINE
39           ALWAYS
40           RELEASE TARRAY(*)
41           RETURN
42      OTHERWISE
43      LET RNI = REAL.F((I-1)/2) - 0.0001
44      LET IK = TRUNC.F(COM12.DISTA(PAR66,RNI,8) + 1)
45      LET ORIG = TARRAY((2*IK) - 1)
46      LET MSG = TARRAY(2*IK)
47      LET MYSET = FMTANK.LIST(ORIG)
48      IF COM.PRINT GT 20
49           PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(CALLNET),
50                TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
```

```
     MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
        +++  SIEZE NET   +++
     SKIP 1 LINE
ALWAYS
REMOVE THIS MSG FROM MAILBAG(MYSET)
SCHEDULE A COMMO.ATTEMPT(ORIG,MSG) NOW
RELEASE TARRAY(*)
RETURN
END
```

```
1       UPON END.XSMN(CALLRT,RECRT,CALLNET,MSG)
2
3         LET ORIG = OWN.TANK(OWN.SUBSCRIBER(CALLRT))
4         LET ADRSEE = ADDRESSEE(MSG)
5         LET TYPE = MSG.TYPE(MSG)
6         LET TEXT.POINTER = MSG.TEXT(MSG)
7         LET MSGNO = MSG.NO(MSG)
8         LET DEST = DEST.CODE(MSG)
9         IF COM.PRINT GT 15
10             PRINT 1 LINE WITH TIME.V AS FOLLOWS
11           END.XSMN EVENT ENTERED AT TIME.V=******.***
12             PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(CALLNET),
13                TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
14           MSG.NO *******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
15              +++    END.XSMN COMPLETED    +++
16        ALWAYS
17        IF COM.PRINT GT 25
18             PRINT 1 LINE WITH DEST.CODE(MSG), LENGTH.MSG(MSG), AND LST.SEND.TIME(MSG)
19                THUS
20           -----DEST.CODE ***  MSG.LENGTH ***.**  KILL.TIME *****.**
21             PRINT 1 LINE WITH MSG, CALLNET, ORIG, AND ADRSEE AS FOLLOWS
22           -----MSG=*********  FMNET=*********  ORIGINATOR=*********  ADDRESSEE=*********
23             PRINT 1 LINE WITH CALLRT AND RECRT AS FOLLOWS
24           -----TRANSMITTER/CALLRT=*********          RECEIVER/RECRT=*********
25             PRINT 1 LINE WITH TEXT.POINTER AS FOLLOWS
26           -----TEXT POINTER=*********
27        ALWAYS
28        SKIP 1 LINE
29        DESTROY THE MESSAGE CALLED MSG
30
31        IF DEST LT 10 GO TO FINISHED
32        ELSE
33        IF CO.IS.DEST.OF.MSG CALL CO.MSG GO TO COMPLETED
34        ELSE
35        IF BN.IS.DEST.OF.MSG CALL BN.MSG GO TO COMPLETED
36        ELSE
37        IF BDE.IS.DEST.OF.MSG CALL BDE.MSG GO TO COMPLETED
38        ELSE
39        IF DIV.IS.DEST.OF.MSG CALL DIV.MSG GO TO COMPLETED
40        ELSE
41        PRINT 1 LINE AS FOLLOWS
42           AN ERROR HAS OCCURRED IN THE TYPE CODE.
43        RETURN
44
45      'COMPLETED'
46        LET TEXT(*) = TEXT.POINTER
47        RELEASE TEXT(*)
48
49      'FINISHED'
50        LET FM.IDLE(CALLNET) = IDLE
```

```
51        LET IN.USE(CALLRT) = IDLE
52        LET IN.USE(RECRT) = IDLE
53        SKIP 1 LINE
54
55        CALL SIEZE.NET(CALLNET)
56
57      RETURN
58      END
59
60
```

APPENDIX EE

```
1       ROUTINE CO.MSG
2
3       IF COM.PRINT GT 20
4            PRINT 1 LINE WITH TIME.V AS FOLLOWS
5            EXECUTION OF CO.MSG ROUTINE AT TIME.V=xxxxxx.xxx
6       ALWAYS
7       IF TYPE LT 20 CALL DEC.CO GO TO EXIT1
8       ELSE
9       'EXIT1'
10      RETURN
11      END
12
13
14      ROUTINE BN.MSG
15
16      IF COM.PRINT GT 20
17           PRINT 1 LINE WITH TIME.V AS FOLLOWS
18           EXECUTION OF BN.MSG ROUTINE AT TIME.V=xxxxxx.xxx
19      ALWAYS
20      IF TYPE LT 30 CALL DEC.BN GO TO EXIT1
21      ELSE
22      'EXIT1'
23      RETURN
24      END
25
26
27      ROUTINE BDE.MSG
28
29      IF COM.PRINT GT 20
30           PRINT 1 LINE WITH TIME.V AS FOLLOWS
31           EXECUTION OF BDE.MSG ROUTINE AT TIME.V=xxxxxx.xxx
32      ALWAYS
33      IF TYPE LT 40 CALL DEC.BDE GO TO EXIT1
34      ELSE
35      'EXIT1'
36      RETURN
37      END
38
39
40      ROUTINE DIV.MSG
41
42      IF COM.PRINT GT 20
43           PRINT 1 LINE WITH TIME.V THUS
44           ENTERED DIV.MSG ROUTINE AT TIME.V = xxxxx.xxx
45      ALWAYS
46      CALL DEC.DIV
47      RETURN
48      END
49
50
```

```
1       UPON DUMP.MAILBAG
2
3       IF COM.PRINT GT 25
4            PRINT 1 LINE WITH TIME.V THUS
5            DUMP MAILBAG EVENT ENTERED AT TIME.V = ******.***
6            SKIP 1 LINE
7       ALWAYS
8         FOR EVERY TANK IN BLUE.ALIVE, DO
9           IF FMTANK.LIST(TANK) IS EQUAL TO ZERO,
10            GO TO LOOP
11          OTHERWISE
12            LET MYSET = FMTANK.LIST(TANK)
13            IF N.MAILBAG(MYSET) EQ 0 GO TO LOOP
14            ELSE
15            FOR EVERY MESSAGE IN MAILBAG(MYSET), DO
16              IF LST.SEND.TIME(MESSAGE) IS LESS THAN TIME.V,
17                REMOVE THE MESSAGE FROM MAILBAG(MYSET)
18                CALL ABORT.MSG(TANK,MESSAGE)
19              REGARDLESS
20            LOOP
21
22      'LOOP'
23        LOOP
24
25      SKIP 1 LINE
26      SCHEDULE A DUMP.MAILBAG IN 600.0 UNITS
27
28      RETURN
29      END
30
31
```

APPENDIX GG

```
1       ROUTINE ABORT.MSG(TNK,MSG)
2
3       IF COM.PRINT GT 20
4            PRINT 1 DOUBLE LINE WITH TIME.V, TK.ID(TNK), MSG.NO(MSG),
5                 MSG.TYPE(MSG), AND TK.ID(  ADDRESSEE(MSG)) LIKE THIS
6            TIME.V  ******.**    TANK ***, MSG.NO *******, TYPE **, TO TANK ***
7               +++   ABORTED DUE TO KILL TIME   +++
8            SKIP 1 LINE
9       ALWAYS
10
11      DESTROY THE MESSAGE CALLED MSG
12      RETURN
13      END
14
15
```

APPENDIX HH

```
1       UPON MSG.GEN(FMNET)
2       DEFINE ADRSEEK, ORT.TEMP, I, NUMBNET, ORT.TEMP, ORTK, AND RNL AS INTEGER
3            VARIABLES
4
5         IF N.CEOI.LIST(FMNET) LT 2
6            PRINT 1 LINE WITH FMNET AS FOLLOWS
7            THERE IS ONLY ONE SUBSCRIBER ON FMNET ******.******
8            GO TO LOOP1
9         ELSE
10        LET RNL = N.CEOI.LIST(FMNET)
11        LET ORTK = COM08.DISTR(PAR02,RNL,2)
12      'DESTGEN'
13        LET ADRSEEK = COM08.DISTR(PAR02,RNL,2)
14        IF ADRSEEK IS EQUAL TO ORTK, GO TO DESTGEN
15        OTHERWISE
16
17        CREATE A MESSAGE CALLED MSG
18        LET I = NUM.NET(FMNET)
19        LET ADDRESSEE(MSG) = RRRPOINT(NETTBL(I,ADRSEEK))
20        LET LST.SEND.TIME(MSG) = TIME.V + 250.0
21        LET LENGTH.MSG(MSG) = COM09.DISTR(PAR62,PAR63,2)
22        LET ORIG = RRRPOINT(NETTBL(I,ORTK))
23        LET MSG.TYPE(MSG) = 0
24        LET MSG.TEXT(MSG)=0
25        LET DEST.CODE(MSG)=0
26        LET MYSET = FMTANK.LIST(ORIG)
27        LET MSG.NO(MSG) = NXT.MSG.NO(MYSET)
28        ADD 1 TO NXT.MSG.NO(MYSET)
29        FOR EVERY RT.CONFIG IN RAD.LIST(MYSET), DO
30           IF OWN.NET(OWN.SUBSCRIBER(RT.CONFIG)) EQ FMNET LET ORT.TEMP=RT.CONFIG
31           ALWAYS
32        LOOP
33        FOR EVERY RT.CONFIG IN RAD.LIST(FMTANK.LIST(ADDRESSEE(MSG))), DO
34           IF OWN.NET(OWN.SUBSCRIBER(RT.CONFIG)) EQ FMNET LET ORT.TEMP=RT.CONFIG
35           ALWAYS
36        LOOP
37
38        IF COM.PRINT GT 15
39           PRINT 1 LINE WITH TIME.V THUS
40           ENTERED MESSAGE GENERATOR AT TIME.V = ******.***
41           PRINT 1 DOUBLE LINE WITH MSG.NO(MSG), MSG.TYPE(MSG), NUM.NET(FMNET),
42                TK.ID(ORIG), AND TK.ID(ADDRESSEE(MSG)) AS FOLLOWS
43           MSG.NO ******  OF TYPE ***  ON NET ***  FROM TANK ***  TO TANK ***
44              +++   GENERATED   +++
45        ALWAYS
46        IF COM.PRINT GT 25
47           PRINT 1 LINE WITH DEST.CODE(MSG), LENGTH.MSG(MSG), AND LST.SEND.TIME(MSG)
48                THUS
49           -----DEST.CODE ***  MSG.LENGTH ***.**  KILL.TIME *****.**
50           PRINT 1 LINE WITH MSG, FMNET, ORIG, AND ADDRESSEE(MSG) AS FOLLOWS
```

```
51          -----MSG=xxxxxxxx  FMNET=xxxxxxxx  ORIGINATOR=xxxxxxxx  ADDRESSEE=xxxxxxxx
52          PRINT 1 LINE WITH ORT.TEMP AND ORT.TEMP AS FOLLOWS
53          -----TRANSMITTER/CALLRT=xxxxxxxx          RECEIVER/RECRT=xxxxxxxx
54        ALWAYS
55        SKIP 1 LINE
56        SCHEDULE A COMM0.ATTEMPT(ORIG,MSG) NOW
57      'LOOP1'
58          LET NUMBNET=(COM10.DISTR(PAR03,N.ETHER,8) - 1)
59          LET FMNET=F.ETHER
60          FOR I = 1 TO NUMBNET, DO
61               LET FMNET = S.ETHER(FMNET)
62          LOOP
63        SCHEDULE A MSG.GEN(FMNET) IN COM01.DISTR(PAR50,PAR51,1) UNITS
64        RETURN
65      END
66
67
```

```
     ENTERED MESSAGE GENERATOR AT TIME.V =    56.604
     MSG.NO   2001  OF TYPE   0  IN NET   1  FROM TANK   2  TO TANK  21                +++   GENERATED   +++

     CALLING DECISION AT TIME.V=   78.113  PCW= 7  CCL= 1  J= 19  T=  992520
22222-----STATUS OF ACTR=  2  OF PHARCW=  1 CAUSED A RETURN

     END.XSMA EVENT ENTERED AT TIME.V=   79.604
     MSG.NO   2001  OF TYPE   0  IN NET   1  FROM TANK   2  TO TANK  21                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =    79.627
     MSG.NO  13001  OF TYPE   0  IN NET   3  FROM TANK  15  TO TANK  23                +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =   105.551
     MSG.NO  24001  OF TYPE   0  IN NET   5  FROM TANK  24  TO TANK  25                +++   GENERATED   +++

     CALLING DECISION AT TIME.V=  155.342  PCW= 6  CCL= 1  J= 12  T=  992968

*****EXECUTING CEN.MOVE.DECISION.MSG ROUTINE AT TIME.V=  155.342
     MSG.NO  12001   FROM   992566  TO   992264  TEXT  1092176  PHARCW  1  ORDER  1  T   992968  CRIT   0              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =   164.408
     MSG.NO  13001  OF TYPE   0  IN NET   3  FROM TANK  13  TO TANK  23                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V=  167.627
     MSG.NO  15001  OF TYPE   0  IN NET   3  FROM TANK  15  TO TANK  23                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V=  181.551
     MSG.NO  24001  OF TYPE   0  IN NET   5  FROM TANK  24  TO TANK  25                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =   190.582
     MSG.NO  26001  OF TYPE   0  IN NET   5  FROM TANK  26  TO TANK  22                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V=  215.627
     MSG.NO  13001  OF TYPE   0  IN NET   3  FROM TANK  13  TO TANK  23                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V=  241.706  PCW= 3  CCL= 1  J= 20  T=  992456

*****EXECUTING CEN.MOVE.DECISION.MSG ROUTINE AT TIME.V=  241.706
     MSG.NO  23001   FROM   992456  TO   992200  TEXT  1091864  PHARCW  1  ORDER  0  T   992456  CRIT   0              RETURN  3

     ENTERED MESSAGE GENERATOR AT TIME.V =   243.504
     MSG.NO  26002  OF TYPE   0  IN NET   4  FROM TANK  20  TO TANK  19                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V=  271.706
     MSG.NO  20001  OF TYPE  20  IN NET   4  FROM TANK  20  TO TANK  24                +++   END.XSMA COMPLETED   +++

     ENT 41 IS RESTRICTED AND CAUSED THE RECURSIVE CC NOT TO MOVE AT   271.706

*****EXECUTING CEN.MOVE.DECISION.MSG ROUTINE AT TIME.V=  271.706
     MSG.NO  24002   FROM   992200  TO   992456  TEXT  1092096  PHARCW  1  ORDER  0  T   992456  CRIT   1              RETURN 14

     ENTERED MESSAGE GENERATOR AT TIME.V =   288.512
     MSG.NO   6001  OF TYPE   0  IN NET   2  FROM TANK   6  TO TANK   8                +++   GENERATED   +++

     CALLING DECISION AT TIME.V=  322.349  PCW= 1  CCL= 1  J=  5  T=  993416
22222-----STATUS OF ACTR=  2  OF PHARCW=  1 CAUSED A RETURN

     END.XSMA EVENT ENTERED AT TIME.V=  328.512
     MSG.NO   6001  OF TYPE   0  IN NET   2  FROM TANK   6  TO TANK   8                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =   341.010
     MSG.NO  10001  OF TYPE   0  IN NET   2  FROM TANK  10  TO TANK   6                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V=  368.575
     MSG.NO  24002  OF TYPE  14  IN NET   4  FROM TANK  24  TO TANK  20                +++   END.XSMA COMPLETED   +++

     COMPANY 20 HAS BEEN ORDERED NOT TO MOVE


     ENTERED MESSAGE GENERATOR AT TIME.V =   374.117
     MSG.NO  22001  OF TYPE   0  IN NET   2  FROM TANK  22  TO TANK   9                +++   GENERATED   +++
```

```
     END.XSMN EVENT ENTERED AT TIME.V= 1334.136
     MSG.NO  9001  OF TYPE  20  CA NET   1  FROM TANK   3  TO TANK  21                 +++   END.XSMN COMPLETED   +++

     UNIT 11 NOT RESTRICTED AND CANCELED COMPANY NOT TO MOVE AT  1334.136

#####CALLING DEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 1334.136
     MSG.NO  21002   FROM   993352  TO   993544  TEXT  1091224  PHASE# 1  ORDER  0  T   993544  CRIT   1              RETURN 12

     ENTERED MESSAGE GENERATOR AT TIME.V =  1347.135
     MSG.NO  15002  OF TYPE   C  CA NET   3  FROM TANK  15  TO TANK  13                 +++   GENERATED   +++

     END.XSMN EVENT ENTERED AT TIME.V= 1350.044
     MSG.NO  11003  OF TYPE   C  CA NET   3  FROM TANK  11  TO TANK  13                 +++   END.XSMN COMPLETED   +++

     CALLING DECISION AT TIME.V= 1376.497  ROW= 2  COL= 2  J=  2  T=  993608
22222-----STATUS OF ACFT=  2  IN PHASE#=  1 CAUSED A RETURN

     END.XSMN EVENT ENTERED AT TIME.V= 1377.044
     MSG.NO  14003  OF TYPE   C  CA NET   3  FROM TANK  14  TO TANK  11                 +++   END.XSMN COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  1389.045
     MSG.NO  21003  OF TYPE   C  CA NET   5  FROM TANK  21  TO TANK  24                 +++   GENERATED   +++

     END.XSMN EVENT ENTERED AT TIME.V= 1400.378
     MSG.NO  21002  OF TYPE  14  CA NET   1  FROM TANK  21  TO TANK   3                 +++   END.XSMN COMPLETED   +++
     COMPANY  3 HAS BEEN CANCELED NOT TO MOVE


     ENTERED MESSAGE GENERATOR AT TIME.V =  1421.235
     MSG.NO   9001  OF TYPE   C  CA NET   2  FROM TANK   9  TO TANK.  6                 +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 1444.391  ROW= 5  COL= 1  J=  3  T=  993544
11111-----UNSPECIFIED BY 1 CAUSED A RETURN

     END.XSMN EVENT ENTERED AT TIME.V= 1447.044
     MSG.NO  12004  OF TYPE   C  CA NET   3  FROM TANK  12  TO TANK  11                 +++   END.XSMN COMPLETED   +++

     END.XSMN EVENT ENTERED AT TIME.V= 1455.045
     MSG.NO  21003  OF TYPE   C  CA NET   5  FROM TANK  21  TO TANK  24                 +++   END.XSMN COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  1481.242
     MSG.NO  15003  OF TYPE   C  CA NET   3  FROM TANK  15  TO TANK  23                 +++   GENERATED   +++

     END.XSMN EVENT ENTERED AT TIME.V= 1521.044
     MSG.NO  15002  OF TYPE   C  CA NET   3  FROM TANK  15  TO TANK  13                 +++   END.XSMN COMPLETED   +++

     CALLING DECISION AT TIME.V= 1527.090  ROW= 2  COL= 1  J=  6  T=  993352

#####CALLING DEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 1527.090
     MSG.NO   6004   FROM   993352  TO   992328  TEXT  1091224  PHASE# 1  ORDER  1  T   993352  CRIT   1              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  1536.569
     MSG.NO  22005  OF TYPE   C  CA NET   5  FROM TANK  22  TO TANK  25                 +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  1584.393
     MSG.NO  13004  OF TYPE   C  CA NET   3  FROM TANK  13  TO TANK  11                 +++   GENERATED   +++

     END.XSMN EVENT ENTERED AT TIME.V= 1596.569
     MSG.NO  22005  OF TYPE   C  CA NET   5  FROM TANK  22  TO TANK  25                 +++   END.XSMN COMPLETED   +++

     CALLING DECISION AT TIME.V= 1604.784  ROW= 2  COL= 2  J= 12  T=  992968

#####CALLING DEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 1604.784
     MSG.NO  12005   FROM   992968  TO   992264  TEXT  1091160  PHASE# 1  ORDER  0  T   992968  CRIT   1              RETURN  3

     ENTERED MESSAGE GENERATOR AT TIME.V =  1621.323
     MSG.NO  14004  OF TYPE   C  CA NET   3  FROM TANK  14  TO TANK  13                 +++   GENERATED   +++
```

```
   BCENT          5   BCECOR          C   BCELC          6   BCEGO          9   BRDE           1   BDEFECST       0.   NO.BDE.UNIT        25
   1                  4                  1                  1                  1                  1                  1                  1

   N.BRIGADE      4   N.DIVISION      1
   1                  1

ATTRIBUTES OF EACH DIV.COMMANDER

   DIVCT          5   DIVCOR          C   DIVLO          5   DIVGO          7   DDIV           1   DIVFECST       0   NO.DIV.UNIT        26
   1                  1                  1                  1                  1                  1                  1                  1

   N.DIVISION     1
   1                  1


     ENTERED MESSAGE GENERATOR AT TIME.V =  2029.182
     MSG.NO  21000  OF TYPE   C  IN NET   5  FROM TANK  21  TO TANK  26                +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  2087.123
     MSG.NO  22007  OF TYPE   C  IN NET   2  FROM TANK  22  TO TANK   6                +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 2088.643  FCN= 4  CCL= 1  J=  3  T=  993544

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 2088.643
     MSG.NO   3002   FROM   993544  TO   992392  TEXT  1090792  PHASE  1  ORDER  1  T   993544  CRIT   1              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  2109.291
     MSG.NO  24007  OF TYPE   C  IN NET   4  FROM TANK  24  TO TANK  18                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 2112.244
     MSG.NO  13007  OF TYPE   C  IN NET   3  FROM TANK  13  TO TANK  12                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 2115.062
     MSG.NO  22006  OF TYPE  3C  IN NET   5  FROM TANK  22  TO TANK  25                +++   END.XSMA COMPLETED   +++

     BDE 1) IS RESTRICTED AND ORDERED THE REQUESTING BN NOT TO MOVE AT  2115.06

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 2115.062
     MSG.NO  25003   FROM   992136  TO   992328  TEXT  1090840  PHASE  1  ORDER  0  T   992328  CRIT   2              RETURN 20

     END.XSMA EVENT ENTERED AT TIME.V= 2143.024
     MSG.NO  24007  OF TYPE   C  IN NET   4  FROM TANK  24  TO TANK  18                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 2148.096
     MSG.NO  22007  OF TYPE   C  IN NET   2  FROM TANK  22  TO TANK   6                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  2162.390
     MSG.NO  22008  OF TYPE   C  IN NET   5  FROM TANK  22  TO TANK  21                +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 2174.404  FCN= 7  CCL= 2  J= 16  T=  992712
33333-----STATUS OF MVARYTRCK=    7,CCL=    2) CAUSED EXIT WITH ORDER=YES

     END.XSMA EVENT ENTERED AT TIME.V= 2174.665
     MSG.NO  24008  OF TYPE   C  IN NET   5  FROM TANK  24  TO TANK  22                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  2187.523
     MSG.NO   7002  OF TYPE   C  IN NET   2  FROM TANK   7  TO TANK  10                +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  2211.535
     MSG.NO  25004  OF TYPE   C  IN NET   5  FROM TANK  25  TO TANK  26                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 2220.616
     MSG.NO  13005  OF TYPE   C  IN NET   3  FROM TANK  13  TO TANK  14                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 2236.019
     MSG.NO  22008  OF TYPE   C  IN NET   5  FROM TANK  22  TO TANK  21                +++   END.XSMA COMPLETED   +++
```

```
ENTERED MESSAGE GENERATION AT TIME.V =  4018.280
MSG.NO  12008  OF TYPE   C  ON NET   3  FROM TANK  12  TO TANK  14                +++   GENERATED   +++

CALLING DECISION AT TIME.V= 4026.949  PCB= 2  CCL= 1  J= 15  I=  992776

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4026.949
MSG.NO  15013   FROM   992776  ID   992264  NEXT  1089928  PHASE#  1  ORDER  1  T   992776  CRIT   1              RETURN  2
*** DECISION BASED ON RANGE TO ENEMY ******
```

ATTRIBUTES OF EACH COMPANY.COMMANDER

	CCNT	CREGST	CCMPY	N.COMP.UNIT	M.BATTALION
1		2	0	1	1
2		2	0	2	1
3		3	1	3	1
4		3	0	4	1
5		3	0	5	1
6		3	0	6	1
7		6	0	7	1
8		6	1	8	1
9		2	0	9	1
10		2	1	10	1
11		1	0	11	1
12		1	1	12	1
13		1	0	13	1
14		1	0	14	1
15		2	0	15	1
16		5	0	16	1
17		5	0	17	1
18		6	0	18	1
19		7	0	19	1
20		2	1	20	1

ATTRIBUTES OF EACH BN.COMMANDER

	BNNT	BNCOR	BNLO	BNGO	BATT	BREGST	NO.EN.UNIT
1		3	3	4	6	1	0 21
2		4	4	2	3	2	1 22
3		3	1	6	8	3	0 23
4		3	2	3	6	4	0 24

	M.BRIGADE	N.BATTALION
1	1	5
2	1	6
3	1	6
4	1	5

ATTRIBUTES OF EACH BDE.COMMANDER

	BDENT	BDECOR	BDELO	BDEGO	BRDE	BDEREGST	NO.BDE.UNIT
1	5	4	6	9	1	0	25

	N.BRIGADE	M.DIVISION
1	4	1

ATTRIBUTES OF EACH DIV.COMMANDER

	DIVNT	DIVCOR	DIVLO	DIVGO	DDIV	DIVREGST	NO.DIV.UNIT
1	5	0	5	7	1	0	26

	N.DIVISION
1	1

```
END.XSMN EVENT ENTERED AT TIME.V= 4038.030
MSG.NO  15011  OF TYPE   C  ON NET   3  FROM TANK  15  TO TANK  11                +++   END.XSMN COMPLETED   +++
```

```
     MSG.NO  17005  OF TYPE   0  CA NET   4  FROM TANK  17  TO TANK  16                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4331.532
     MSG.NO   6009  OF TYPE   0  CA NET   2  FROM TANK   6  TO TANK   8                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4344.677  RCM= 7  CCL= 1  J= 16  I=  992712

&&&&&EXECUTING DEM.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4344.677
     MSG.NO  16004   FROM   992712  TO   992200  TEXT  1089816  PHARCH  1  ORDER  1  T   992712  CRIT   1              RETURN  1
     +++ DECISION BASED ON RANGE TO ENEMY ++++++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4357.191
     MSG.NO  12010  OF TYPE   0  CA NET   3  FROM TANK  12  TO TANK  15                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4362.263
     MSG.NO  24012  OF TYPE  30  CA NET   5  FROM TANK  24  TO TANK  25                +++   END.XSMA COMPLETED   +++

     UNIT ID IS RESTRICTED AND IS REQUESTING PERMISSION TO MOVE AT  4362.28300

&&&&&EXECUTING DEM.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4362.283
     MSG.NO  25006   FROM   992136  TO   992072  TEXT  1089952  PHARCH  1  ORDER  0  T   992136  CRIT   2              RETURN 19

     ENTERED MESSAGE GENERATOR AT TIME.V =  4364.735
     MSG.NO  22013  OF TYPE   0  CA NET   5  FROM TANK  22  TO TANK  25                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4421.555
     MSG.NO  16004  OF TYPE  21  CA NET   4  FROM TANK  16  TO TANK  24                +++   END.XSMA COMPLETED   +++

44444++++++00   992712 NOTIFIED EA   992200 BY MESSAGE (TEXT= 1089816) THAT IT IS MOVING FROM ITS CURRENT POSITION.

&&&&&EXECUTING DEM.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4421.555
     MSG.NO  16005   FROM   992712  TO   992136  TEXT  1089904  PHARCH  1  ORDER  1  T   992200  CRIT   1              RETURN 16

     ENTERED MESSAGE GENERATOR AT TIME.V =  4427.765
     MSG.NO  25007  OF TYPE   0  CA NET   5  FROM TANK  25  TO TANK  22                +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 4428.505  RCM= 1  CCL= 1  J= 12  I=  992568
1111+-----CROSSTRACK IS 1 CALSEE A RETURN

     END.XSMA EVENT ENTERED AT TIME.V= 4435.735
     MSG.NO  22013  OF TYPE   0  CA NET   5  FROM TANK  22  TO TANK  25                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4473.557
     MSG.NO  19003  OF TYPE   0  CA NET   4  FROM TANK  19  TO TANK  17                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4478.735
     MSG.NO  25007  OF TYPE   0  CA NET   5  FROM TANK  25  TO TANK  22                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4493.291  RCM= 4  CCL= 1  J= 14  T=  992840

&&&&&EXECUTING DEM.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4493.291
     MSG.NO  19007   FROM   992840  TO   992264  TEXT  1089792  PHARCH  1  ORDER  1  T   992840  CRIT   1              RETURN  1
     +++ DECISION BASED ON RANGE TO ENEMY ++++++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4494.259
     MSG.NO  23012  OF TYPE   0  CA NET   5  FROM TANK  23  TO TANK  24                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4496.557
     MSG.NO  19003  OF TYPE   0  CA NET   4  FROM TANK  19  TO TANK  17                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4515.465
     MSG.NO  24013  OF TYPE   0  CA NET   5  FROM TANK  24  TO TANK  21                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4522.557
     MSG.NO  17005  OF TYPE   0  CA NET   4  FROM TANK  17  TO TANK  16                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4546.265
     MSG.NO  23012  OF TYPE   0  CA NET   5  FROM TANK  23  TO TANK  24                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4556.535  RCM= 7  CCL= 1  J=  5  I=  993416
22222-----STATUS OF ACM=  2  CT PHARCH=  1 CALSEE A RETURN
```

```
     ENTERED MESSAGE GENERATOR AT TIME.V =  4576.043
     MSG.NO  22014  OF TYPE   C  CA NET   5  FROM TANK  22  TO TANK  24                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4578.259
     MSG.NO  16005  OF TYPE  21  CA NET   5  FROM TANK  24  TO TANK  25                +++   END.XSMA COMPLETED   +++

AAAAA******A   992200 NOTIFIED ECE   992136 BY MESSAGE (TEXT= 1089904) THAT ONE OF ITS COMPANIES IS MOVING FROM ITS POSITION.

     CALLING DECISION AT TIME.V= 4622.267  ROW= 2  COL= 2  J= 11  I=  993C32

BBBBBEXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4622.267
     MSG.NO  11008   FROM  993032  TO  992264  TEXT  1089904  PHASE= 1  ORDER  1  T   993C32  CRIT   1              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  4624.223
     MSG.NO  13005  OF TYPE   C  CA NET   3  FROM TANK  13  TO TANK  11                +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4641.277
     MSG.NO  14CCE  OF TYPE   C  CA NET   3  FROM TANK  14  TO TANK  12                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4680.223
     MSG.NO  13005  OF TYPE   C  CA NET   3  FROM TANK  13  TO TANK  11                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4684.605  ROW= 4  COL= 2  J=  9  I=  99316C

BBBBBEXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4684.605
     MSG.NO   9004   FROM  993160  TO  992228  TEXT  1089728  PHASE= 1  ORDER  1  T   993160  CRIT   1              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  4699.529
     MSG.NO  22015  OF TYPE   C  CA NET   2  FROM TANK  22  TO TANK  10                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4700.334
     MSG.NO  24013  OF TYPE   C  CA NET   5  FROM TANK  24  TO TANK  21                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4734.101
     MSG.NO  14006  OF TYPE   C  CA NET   3  FROM TANK  14  TO TANK  12                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4744.546
     MSG.NO  24014  OF TYPE   C  CA NET   5  FROM TANK  24  TO TANK  25                +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 4745.748  ROW= 2  COL= 1  J= 18  I=  992584

BBBBBEXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4745.748
     MSG.NO  13009   FROM  992224  TO  992200  TEXT  1089016  PHASE= 1  ORDER  1  T   992584  CRIT   1              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     END.XSMA EVENT ENTERED AT TIME.V= 4746.709
     MSG.NO  22012  OF TYPE   C  CA NET   2  FROM TANK  22  TO TANK   7                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4755.656
     MSG.NO  24015  OF TYPE   C  CA NET   4  FROM TANK  24  TO TANK  17                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4766.177
     MSG.NO  25006  OF TYPE  40  CA NET   5  FROM TANK  25  TO TANK  26                +++   END.XSMA COMPLETED   +++

     DIVE II NOT RESTRICTED AND CAVE DOES PERMISSION TO MOVE AT  4766.177

BBBBBEXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4766.177
     MSG.NO  25008   FROM  992136  TO  992136  TEXT  1089544  PHASE= 1  ORDER  0  T   992136  CRIT   5              RETURN 22

     CALLING DECISION AT TIME.V= 4808.274  ROW= 1  COL= 2  J=  4  I=  993480

BBBBBEXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 4808.274
     MSG.NO   4001   FROM  992460  TO  992392  TEXT  1089472  PHASE= 1  ORDER  1  T   993480  CRIT   5              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     END.XSMA EVENT ENTERED AT TIME.V= 4810.101
     MSG.NO  12010  OF TYPE   C  CA NET   3  FROM TANK  12  TO TANK  15                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4817.401
     MSG.NO   9005  OF TYPE   C  CA NET   2  FROM TANK   9  TO TANK  22                +++   GENERATED   +++
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     END.XSMA EVENT ENTERED AT TIME.V= 4819.035
     MSG.NO  24014  OF TYPE   0  CA NET   5  FROM TANK  24  TO TANK  25                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4851.570
     MSG.NO  15014  OF TYPE   0  CA NET   3  FROM TANK  15  TO TANK  13                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4852.709
     MSG.NO  22015  OF TYPE   0  CA NET   2  FROM TANK  22  TO TANK  10                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4875.656
     MSG.NO  24015  OF TYPE   0  CA NET   4  FROM TANK  24  TO TANK  17                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4876.816  ROW= 3  COL= 2  J= 15  I=  992776

&&&&&EXECUTING CEN.MOVE.DECISION.MSL ROUTINE AT TIME.V= 4876.816
     MSG.NO  15015   FROM   992776  TO   992264  TEXT  1089952  PHASE#  1  ORDER  1  T   992776  CRIT   5              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  4903.167
     MSG.NO   6013  OF TYPE   0  CA NET   2  FROM TANK   6  TO TANK   9                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4921.039
     MSG.NO  22014  OF TYPE   0  CA NET   5  FROM TANK  22  TO TANK  24                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  4938.682
     MSG.NO  18010  OF TYPE   0  CA NET   4  FROM TANK  18  TO TANK  20                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4945.412
     MSG.NO   9005  OF TYPE   0  CA NET   2  FROM TANK   9  TO TANK  22                +++   END.XSMA COMPLETED   +++

     CALLING DECISION AT TIME.V= 4945.424  ROW= 3  COL= 1  J= 16  I=  992712

&&&&&EXECUTING CEN.MOVE.DECISION.MSL ROUTINE AT TIME.V= 4945.424
     MSG.NO  16016   FROM   992712  TO   992200  TEXT  1089408  PHASE#  1  ORDER  1  T   992712  CRIT   5              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     ENTERED MESSAGE GENERATOR AT TIME.V =  4966.822
     MSG.NO  26005  OF TYPE   0  CA NET   5  FROM TANK  26  TO TANK  25                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 4988.882
     MSG.NO  18010  OF TYPE   0  CA NET   4  FROM TANK  18  TO TANK  20                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  5006.686
     MSG.NO  19004  OF TYPE   0  CA NET   4  FROM TANK  19  TO TANK  17                +++   GENERATED   +++

     CALLING DECISION AT TIME.V= 5021.000  ROW= 6  COL= 2  J= 18  I=  992584
3333------STATUS OF AVAIL(ROW=    8,COL=    2) CALSED EXIT WITH ORDER=YES

     ENTERED MESSAGE GENERATOR AT TIME.V =  5026.829
     MSG.NO  21011  OF TYPE   0  CA NET   5  FROM TANK  21  TO TANK  26                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5037.149
     MSG.NO  26005  OF TYPE   0  CA NET   5  FROM TANK  26  TO TANK  25                +++   END.XSMA COMPLETED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5062.015
     MSG.NO   6013  OF TYPE   0  CA NET   2  FROM TANK   6  TO TANK   9                +++   END.XSMA COMPLETED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  5070.821
     MSG.NO  16011  OF TYPE   0  CA NET   4  FROM TANK  18  TO TANK  16                +++   GENERATED   +++

     ENTERED MESSAGE GENERATOR AT TIME.V =  5093.803
     MSG.NO  16007  OF TYPE   0  CA NET   4  FROM TANK  16  TO TANK  17                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5097.149
     MSG.NO  25008  OF TYPE  33  CA NET   5  FROM TANK  25  TO TANK  25                +++   END.XSMA COMPLETED   +++
     UNIT 11 NOT RESTRICTED, AND CAVE HAS PERMISSION TO MOVE AT  5097.149
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*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5097.149
     MSG.NO  25005   FROM   992136  TO   992392  NEXT  1089040  PHASE#  1  ORDER  0  T   992392  CRIT   3              RETURN  6

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5097.149
     MSG.NO  25010   FROM   992136  TO   992328  NEXT  1089216  PHASE#  1  ORDER  0  T   992328  CRIT   3              RETURN  6

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5097.149
     MSG.NO  25011   FROM   992136  TO   992264  NEXT  1089128  PHASE#  1  ORDER  0  T   992264  CRIT   3              RETURN  6

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5097.149
     MSG.NO  25012   FROM   992136  TO   992200  NEXT  1089040  PHASE#  1  ORDER  0  T   992200  CRIT   3              RETURN  6

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5097.149
     MSG.NO  25013   FROM   992136  TO   992072  NEXT  1088952  PHASE#  1  ORDER  0  T   992136  CRIT   3              RETURN 18
CCCCC*****ABE   992136 NOTIFIED CEN   992072 BY MESSAGE NO  25013 THAT IT HAS GIVEN ALL BATTALIONS PERMISSION TO MOVE AT WILL.

     CALLING DECISION AT TIME.V= 5110.440  ROW= 5  COL= 1  J= 15  T=  992776

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5110.440
     MSG.NO  25016   FROM   992264  TO   992264  NEXT  1089544  PHASE#  1  ORDER  1  T   992776  CRIT   3              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     END.ASMN EVENT ENTERED AT TIME.V= 5120.149
     MSG.NO  21011  OF TYPE   0  IN NET   5  FROM TANK  21  TO TANK  26                 ***   END.XSMN COMPLETED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5125.603
     MSG.NO  24016  OF TYPE   0  IN NET   4  FROM TANK  24  TO TANK  19                 ***   GENERATED   ***

     END.ASMN EVENT ENTERED AT TIME.V= 5139.552
     MSG.NO  18011  OF TYPE   0  IN NET   4  FROM TANK  18  TO TANK  16                 ***   END.XSMN COMPLETED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5142.582
     MSG.NO  10007  OF TYPE   0  IN NET   2  FROM TANK  10  TO TANK   8                 ***   GENERATED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5165.747
     MSG.NO  10008  OF TYPE   0  IN NET   2  FROM TANK  10  TO TANK   9                 ***   GENERATED   ***

     CALLING DECISION AT TIME.V= 5198.317  ROW= 4  COL= 2  J=  3  T=  993544

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5198.317
     MSG.NO   3003   FROM   993544  TO   992392  NEXT  1089104  PHASE#  1  ORDER  1  T   993544  CRIT   3              RETURN  1
     *** DECISION BASED ON RANGE TO ENEMY ******

     END.ASMN EVENT ENTERED AT TIME.V= 5217.552
     MSG.NO  24016  OF TYPE   0  IN NET   4  FROM TANK  24  TO TANK  19                 ***   END.XSMN COMPLETED   ***

     END.ASMN EVENT ENTERED AT TIME.V= 5222.459
     MSG.NO  25009  OF TYPE  23  IN NET   5  FROM TANK  25  TO TANK  21                 ***   END.XSMN COMPLETED   ***

     BAT 11 NOT RESTRICTED AND GAVE CCS PERMISSION TO MOVE AT  5222.459

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21012   FROM   992392  TO   993072  NEXT  1089016  PHASE#  1  ORDER  0  T   992672  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21013   FROM   992392  TO   993008  NEXT  1088864  PHASE#  1  ORDER  0  T   993008  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21014   FROM   992392  TO   993544  NEXT  1088720  PHASE#  1  ORDER  0  T   993544  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21015   FROM   992392  TO   993480  NEXT  1088632  PHASE#  1  ORDER  0  T   993480  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21016   FROM   992392  TO   993416  NEXT  1088544  PHASE#  1  ORDER  0  T   993416  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5222.459
     MSG.NO  21017   FROM   992392  TO   992136  NEXT  1088456  PHASE#  1  ORDER  0  T   992392  CRIT   3              RETURN 11
EGGGG*****GEN   992392 NOTIFIED EEE   992136 BY MESSAGE NO  21017 THAT IT HAS GIVEN ALL COMPANIES PERMISSION TO MOVE AT WILL.

     END.ASMN EVENT ENTERED AT TIME.V= 5232.562
     MSG.NO  10007  OF TYPE   0  IN NET   2  FROM TANK  10  TO TANK   8                 ***   END.XSMN COMPLETED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5236.565
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     MSG.NO  23010  OF TYPE   C  CA NET   3  FROM TASK  13  TO TASK  23                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5259.626
     MSG.NO  25011  OF TYPE  23  CA NET   5  FROM TASK  25  TO TASK  23                +++   END.XSMA COMPLETED   +++

     BNI 31 NOT RESTRICTED AND CAVE CCS PERMISSION TO MOVE AT  5259.626

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23013   FROM   992264  TO   993032  TEXT  1089520  PHARCH  1  ORDER  0  T   992032  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23014   FROM   992264  TO   992968  TEXT  1089192  PHARCH  1  ORDER  0  T   992968  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23015   FROM   992264  TO   992904  TEXT  1088272  PHARCH  1  ORDER  0  T   992904  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23016   FROM   992264  TO   992840  TEXT  1088184  PHARCH  1  ORDER  0  T   992840  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23017   FROM   992264  TO   992776  TEXT  1088096  PHARCH  1  ORDER  0  T   992776  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5259.626
     MSG.NO  23018   FROM   992264  TO   992136  TEXT  1088008  PHARCH  1  ORDER  0  T   992264  CRIT   3              RETURN 11
&&&&&&&&&&&  992264 NOTIFIED EGE   992136 BY MESSAGE NO  23018 THAT IT HAS GIVEN ALL COMPANIES PERMISSION TO MOVE AT WILL.

     CALLING DECISION AT TIME.V= 5264.941  RCH= 4  CCL= 1  J= 20  T=  992456

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5264.941
     MSG.NO  23006   FROM   992456  TO   992200  TEXT  1088608  PHARCH  1  ORDER  1  T   992456  CRIT   3              RETURN 1
     +++ DECISION BASED ON RANGE TO ENEMY ++++++

     ENTERED MESSAGE GENERATOR AT TIME.V =  5270.555
     MSG.NO  24017  OF TYPE   C  CA NET   4  FROM TASK  24  TO TASK  18                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5288.582
     MSG.NO  10008  OF TYPE   C  CA NET   2  FROM TASK  10  TO TASK   9                +++   END.XSMA COMPLETED   +++


     END.XSMA EVENT ENTERED AT TIME.V= 5309.719
     MSG.NO  10007  OF TYPE   C  CA NET   4  FROM TASK  16  TO TASK  17                +++   END.XSMA COMPLETED   +++


     ENTERED MESSAGE GENERATOR AT TIME.V =  5310.679
     MSG.NO  22016  OF TYPE   C  CA NET   2  FROM TASK  22  TO TASK   9                +++   GENERATED   +++

     END.XSMA EVENT ENTERED AT TIME.V= 5329.886
     MSG.NO  25012  OF TYPE  23  CA NET   5  FROM TASK  25  TO TASK  24                +++   END.XSMA COMPLETED   +++

     BNI 41 NOT RESTRICTED AND CAVE CCS PERMISSION TO MOVE AT  5329.886

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24018   FROM   992200  TO   992712  TEXT  1089384  PHARCH  1  ORDER  0  T   992712  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24019   FROM   992200  TO   992648  TEXT  1088432  PHARCH  1  ORDER  0  T   992648  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24020   FROM   992200  TO   992584  TEXT  1088248  PHARCH  1  ORDER  0  T   992584  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24021   FROM   992200  TO   992520  TEXT  1088336  PHARCH  1  ORDER  0  T   992520  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24022   FROM   992200  TO   992456  TEXT  1089840  PHARCH  1  ORDER  0  T   992456  CRIT   3              RETURN 10

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5329.886
     MSG.NO  24023   FROM   992200  TO   992136  TEXT  1087720  PHARCH  1  ORDER  0  T   992200  CRIT   3              RETURN 11
&&&&&&&&&&&  992200 NOTIFIED EGE   992136 BY MESSAGE NO  24023 THAT IT HAS GIVEN ALL COMPANIES PERMISSION TO MOVE AT WILL.

     END.XSMA EVENT ENTERED AT TIME.V= 5334.550
     MSG.NO  21013  OF TYPE  13  CA NET   1  FROM TASK  21  TO TASK   2                +++   END.XSMA COMPLETED   +++

     COMPANY  2 HAS BEEN GIVEN PERMISSION TO MOVE AT WILL


     END.XSMA EVENT ENTERED AT TIME.V= 5346.589
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     END.XSMA EVENT ENTERED AT TIME.V= 5750.399
     MSG.NO  25010  OF TYPE  23  CA NET   5  FROM TANK  25  TO TANK  22                    ***   END.XSMA COMPLETED   ***

     DRIVE 21 NOT RESTRICTED AND GAVE GOOD PERMISSION TO MOVE AT  5750.399

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22017   FROM   992320  TO   993352  TEXT  1088184  PARCW  1  ORDER  0  T   992352  CRIT   3              RETURN TO

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22018   FROM   992320  TO   993288  TEXT  1088544  PARCW  1  ORDER  0  T   992288  CRIT   3              RETURN TO

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22019   FROM   992320  TO   993224  TEXT  1088632  PARCW  1  ORDER  0  T   992224  CRIT   3              RETURN TO

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22020   FROM   992320  TO   993160  TEXT  1089192  PARCW  1  ORDER  0  T   992160  CRIT   3              RETURN TO

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22021   FROM   992320  TO   993096  TEXT  1089016  PARCW  1  ORDER  0  T   992096  CRIT   3              RETURN TO

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5750.399
     MSG.NO  22022   FROM   992320  TO   992136  TEXT  1088520  PARCW  1  ORDER  0  T   992328  CRIT   3              RETURN 11
88886*****BR   992320 ACTIFIED GEE   992136 BY MESSAGE NO  22022 THAT IT HAS GIVEN ALL COMPANIES PERMISSION TO MOVE AT WILL.

     END.XSMA EVENT ENTERED AT TIME.V= 5755.253
     MSG.NO  24025  OF TYPE   0  CA NET   4  FROM TANK  24  TO TANK  20                    ***   END.XSMA COMPLETED   ***

     END.XSMA EVENT ENTERED AT TIME.V= 5762.074
     MSG.NO  12012  OF TYPE   0  CA NET   3  FROM TANK  12  TO TANK  11                    ***   END.XSMA COMPLETED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5764.557
     MSG.NO   6011  OF TYPE   0  CA NET   2  FROM TANK   6  TO TANK   8                    ***   GENERATED    ***

     END.XSMA EVENT ENTERED AT TIME.V= 5795.557
     MSG.NO   6011  OF TYPE   0  CA NET   2  FROM TANK   6  TO TANK   8                    ***   END.XSMA COMPLETED   ***

     ENTERED MESSAGE GENERATOR AT TIME.V =  5802.244
     MSG.NO  24027  OF TYPE   0  CA NET   5  FROM TANK  24  TO TANK  22                    ***   GENERATED    ***

     END.XSMA EVENT ENTERED AT TIME.V= 5815.252
     MSG.NO  24022  OF TYPE  13  CA NET   4  FROM TANK  24  TO TANK  20                    ***   END.XSMA COMPLETED   ***

     COMPANY 20 HAS BEEN GIVEN PERMISSION TO MOVE AT WILL


     END.XSMA EVENT ENTERED AT TIME.V= 5816.495
     MSG.NO  25013  OF TYPE  41  CA NET   5  FROM TANK  25  TO TANK  26                    ***   END.XSMA COMPLETED   ***

     DRIVE 11 NOT RESTRICTED AND GAVE GOOD PERMISSION TO MOVE AT  5816.495

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5816.495
     MSG.NO  25017   FROM   992136  TO   992136  TEXT  1089840  PARCW  1  ORDER  0  T   992136  CRIT   3              RETURN 22

     CALLING DECISION AT TIME.V= 5824.360  RCW= 6  CCL= 1  J= 16  I=  992712
33333-----STATUS OF XVARYING.=    8,CCL=    11 CALLED EXIT WITH ORDER=YES

     ENTERED MESSAGE GENERATOR AT TIME.V =  5835.767
     MSG.NO   5006  OF TYPE   0  CA NET   2  FROM TANK   9  TO TANK  22                    ***   GENERATED    ***

     END.XSMA EVENT ENTERED AT TIME.V= 5836.074
     MSG.NO  11010  OF TYPE   0  CA NET   3  FROM TANK  11  TO TANK  12                    ***   END.XSMA COMPLETED   ***

     END.XSMA EVENT ENTERED AT TIME.V= 5861.253
     MSG.NO  17007  OF TYPE   0  CA NET   4  FROM TANK  17  TO TANK  19                    ***   END.XSMA COMPLETED   ***

     END.XSMA EVENT ENTERED AT TIME.V= 5871.839
     MSG.NO  24024  OF TYPE  31  CA NET   5  FROM TANK  25  TO TANK  26                    ***   END.XSMA COMPLETED   ***

     DRIVE 11 NOT RESTRICTED AND GAVE GOOD PERMISSION TO MOVE AT  5871.839

*****EXECUTING GEN.MOVE.DECISION.MSG ROUTINE AT TIME.V= 5871.839
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